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FILMING A RECORD-BREAKING MOTORBOAT [See page 315]

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SEVENTY-FIFTH YEAR

# SCIENTIFIC AMERICAN

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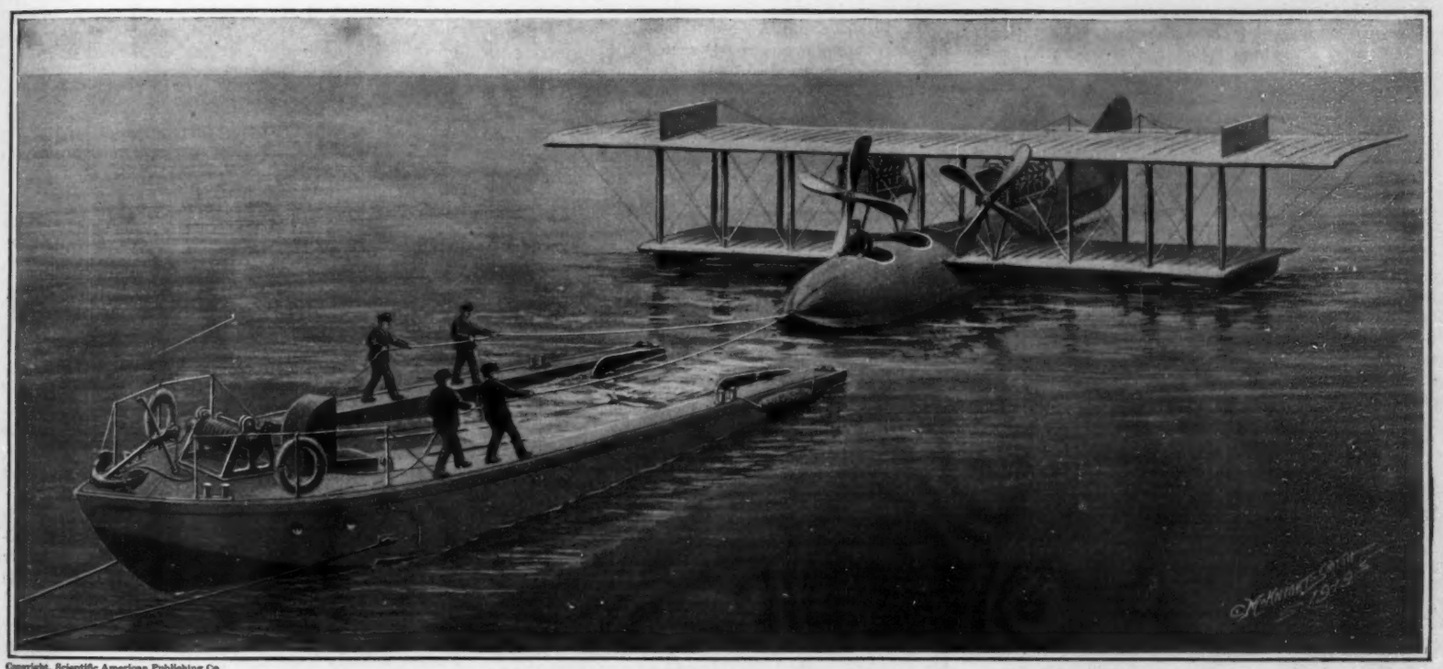




**Loading a seaplane aboard one of the seaplane-towing barges of the British Navy, by means of a hand-operated windlass**

## A Towing Barge for the Huge Naval Planes

NAVAL aviation was developed to a far greater extent during the war than the public was permitted to believe. Unlike military aviation, where the developments and tendencies were more or less known to the world at large during the war, naval aviation has been enshrouded in the blackest and most impenetrable smoke screen of the censors; indeed, it is only during the past few days that the facts are becoming known as regards the winged branch of the naval forces.

Along with the diminutive Sopwith "Camels" or single-seater biplanes which the British Navy launched from platforms erected on a pair of long guns of any cruiser, it is now divulged for the first time that both British and American naval forces made use of towing barges or lighters for transporting big seaplanes to distant points. These barges served the purpose of towing seaplanes to somewhere near enemy points, by means of fast torpedo-boat destroyers, so as to lessen the flying distance.

It will be noted from the accompanying illustrations that these barges follow the usual hydroplane lines. A compartment at the rear of the craft is employed as a trimming tank, which is blown out by compressed-air flasks. Four hand pumps of drawn brass tube are used for handling water ballast and draining the vessel. A windlass is mounted at the forward end. This windlass is fitted with two drums, one for handling 2½-inch flexible steel wire rope so that the hauling wire can be wound on to it, and the other for $\frac{1}{16}$-inch cable chain.

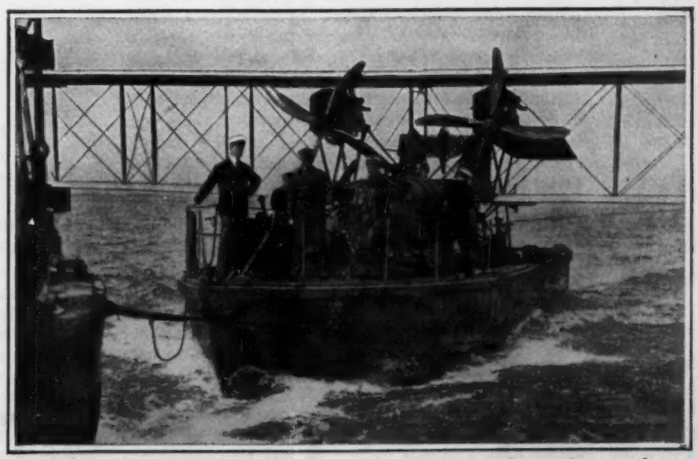
The barge takes the seaplane on board by means of a cradle or trolley, which runs on a pair of rails. This trolley is composed of two parts, the after part being hinged to the foremost or main portion. The forepart is carried on ten flanged rollers, each 3 inches in diameter and 2¼ inches wide on the bearing surface. The top of the framework of the cradle is laid with portable sets of fir battens. Clips to prevent the trolley lifting from the rails, are provided. Also, four automatic hinged catches are provided for holding the cradle in the receiving position and in the stowing position.

From what has already been read, it will be noted that the seaplane or flying boat is stowed on the cradle running on the fore and aft rails on the inner bottom of the lighter. To ship the flying boat or seaplane, the cradle is run down the rails to the extreme after end of the lighter. The later is then trimmed down aft by flooding a water ballast compartment by means of a Kingston valve, sufficient draught of water being obtained to allow of the flying boat or seaplane being floated on to the cradle.

The cradle, with its load, is now hauled up the rails by means of the hand windlass at the bow, to the stowing position, which is approximately midships, where it is secured. The water in the ballast compartment at the rear is then blown out by compressed air stored in bottles carried on board the lighter, bringing the craft to an even keel for towing. The towing eyes are fitted to each side of the barge, some distance back from the bow, a bridle being used. By this means any tendency for the lighter to deviate from her true course is corrected by one or the other of the legs of the bridle bearing on the forepart of the lighter and thus bringing her back to her true course. Three skegs are fitted aft for the same purpose.

It is said that these lighters have been towed by destroyers at speeds up to 35 knots with flying boats on board. To prevent the flying boat or seaplane, as the case may be, from lifting off the trolley when the barge is being towed at high speed, two wing supports are provided at each side. When the desired point for making an attack is reached, the plane is launched by reversing the loading operation.

In the upper illustration is depicted the method of shipping the seaplane, while the lower shows the barge under way.



**Medium sized seaplane on board a barge which is towed sometimes at the rate of 35 knots an hour**

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Hurley and the Shipping Situation

THE Chairman of the United States Shipping Board returns from his three months' stay in Europe with a mass of first-hand information regarding the shipping situation in the maritime world, and the American public will be glad to know that one effect of his investigation has been to make him very optimistic as to the future of American shipping. He believes that the obstacle of inexperience will quickly give way before American industrial strength and energy. Our progress will be facilitated by the widespread upheaval which has occurred in the maritime world. As evidence of the changed conditions, he makes the startling statement that the difference in wages here and abroad is today practically negligible, the pay given to British seamen during the war being $72 a month as compared with our pay of $75 a month. Furthermore, he would have us remember that wages form only a part of the issues now raised by the seamen of the world. He found that the conditions of living for the seamen aboard ship and the recognition of their rights as citizens, even upon the sea, overshadow the wage question. Our own Shipping Board has provided comfortable quarters "fit for Americans to live in"; and, says Mr. Hurley, "The seamen of other nations, as I found during my stay abroad, are intent upon obtaining the same treatment aboard ship." Another effect which will undoubtedly be of great assistance to our merchant marine was the action of the Commission of International Labor Legislation, appointed by the Peace Conference at Paris, which has accepted the principle of uniformity throughout the world of seamen's wages.

Everyone is interested, or should be, to know exactly what has been the effect of the war upon the shipping tonnage of the world, and Mr. Hurley's figures may be taken as the latest and most accurate. From them we learn that the steam seagoing merchant tonnage of the world in July, 1914, was 41,225,000 gross tons; that there has been a net loss of 4,245,000 tons and that to this should be added the loss, through failure of normal increase by new construction, of 12,000,000 tons, making a present world shortage, over what would have been afloat had the war never occurred, of 16,245,000 tons. The losses to the Allies and neutrals by enemy action, by marine risk, and by capture or seizure by the enemy, amounted to 15,218,000 tons. The Allied gains during the war were, by new construction 11,856,000 gross tons, and by capture or seizure from the enemy, 2,393,000 gross tons, making a total gain of 14,249,000 gross tons. The net loss, therefore, to the Allies and neutrals was 969,000 tons.

The figures for the gross losses to individual nations through enemy action are very impressive. Out of a total for the Allies and neutrals of 12,815,000 tons, Great Britain lost 7,753,746 gross tons; Norway, 1,178,335 tons; France, 907,168 tons; Italy, 852,124 tons; and the United States 383,987 tons, the percentages varying from 36.8 per cent for Great Britain to 7.2 per cent for the United States.

During the war Great Britain built and acquired sufficient tonnage to reduce her net loss to 3,443,000 tons and during the same period we increased our shipping to the extent of 3,370,868 tons. As the result of his survey of the British yards, Mr. Hurley reached the conclusion that under favorable conditions the British may reach or even exceed the 3,000,000 gross tons output predicted for 1919. Moreover, he found that France, Japan and Italy have ambitious programs of construction. France wishes to buy a million tons of ships built in Great Britain and a like amount of ships built in America, and wishes to have constructed in American yards another two million tons of cargo steamers. Italy expects in three years' time to have four million gross tons and Japan has a program for this year of 793,000 gross tons. Norway and Sweden are laying plans for the active upbuilding of their fleets, and even Switzerland intends to construct a merchant navy, when canal improvements are made on the Rhine, which will bring raw materials in exchange for manufactured goods.

Finally, it is Mr. Hurley's conviction that if the natural and desirable expansion of the foreign trade of the United States is to take place, three conditions must be fulfilled. First, to distribute American products and bring in imports through American agencies and largely in American ships, we must find or develop seven men with experience in handling foreign trade where there was but one man in 1914. Secondly, we must recruit an American personnel for the operation of the ships and the handling of the work at our ports. Lastly, we must make a permanent and increasing extension of our banking facilities.

## The Humanity of Poison Gas

IN view of the feelings with which civilization received the news of the first poison gas attack, in which horror and indignation contended for the mastery, there is, at its first announcement, something ironic in the statement of our military men that poison gas is today a more humane form of attack than high-explosive shell. But lest this be taken as any condoning of that German horror at the Ypres salient, we hasten to add that the humanity of poison gas warfare is not due to the Germans, but to the ingenuity of the Allies in providing effective gas-masks and developing suitable medical and hygienic treatment for those who have been gassed. Germany intended the poison gas to be just as horrible in its effects, just as cruel and excruciating in the lingering deaths imposed, as it proved to be.

So greatly have the horrors of gas attack been mitigated since its first introduction, that in the opinion of Brig.-Gen. Amos A. Fries, who was in command of the Chemical Warfare Service of our army at the front, it is possible that gas warfare may come to be recognized as a lawful method of warfare and that it will not be eliminated. The argument as presented by him is also endorsed by Colonel Walker, who is in command of the Edgewood plant for the manufacture of gas, of which we give a description elsewhere in this issue.

The question of the "humanity of gas warfare" is of course closely tied up with that of the preparedness of the enemy against this form of attack; but the statistics of the war, contrary to general belief, have shown that the casualties and permanent injuries due to gas attack against troops that are adequately prepared against it, are far less than those suffered from shrapnel and high explosive shell. Thus, we are told that out of every 100 casualties of all kinds suffered by our troops in battle, 70 per cent were caused by high explosive shell, shrapnel, bullets, etc., and 30 per cent were due to gas, the gas, of course, being thrown in shells fired from standard guns.

But it is when we come to the matter of the percentage of deaths to casualties, that we discover the surprising fact that the deaths from gas were only five per cent of the total deaths, or to put it in another way, out of every 100 casualties due to gas, three to four died; whereas out of every 100 wounded with high explosive, bullets, shrapnel, etc., twenty to twenty-five died, and among the deaths from gas are included those from pneumonia and other lung complications due to the patients having been gassed.

Another so-called humanitarian feature of gas warfare is the fact that whereas there are 3,000 men of our expeditionary force who have lost either an arm or a leg from shell and rifle fire and a considerable number who have lost their sight, not a single man of our troops has been permanently blinded by gas.

As pointed out by Col. William H. Walker, who is better known to our readers as the Director of the Institute Course in Chemical Engineering at the Massachusetts Institute of Technology, gas warfare is effective, largely because the troops that are subjected to continued exposure to gas and, therefore, have to wear their masks for several hours, lose a great deal of their efficiency, even to the extent of rendering it necessary to remove them from the gassed areas. It was the heavy gassing of the back areas, and particularly of the reserve troops back of the British front lines, resulting in loss of efficiency among those troops due to their having to wear gas masks, that contributed-so largely to the German success in the great drive of March, 1918. And the slowing up of that offensive and its ultimate loss of driving power were due largely to the fact that the Germans ran out of gas.

If these facts are well established, and they rest upon the highest authority, it becomes a question whether prudence and farsightedness do not suggest the maintenance of our great gas factory at Edgewood Arsenal as a permanent military asset of the country. If a small force, sufficient to care for the plant, were maintained there, we should have at hand, capable of immediate operation, a military asset far exceeding in its potentialities anything of the kind in the world today.

## England to France by Rail

IT was inevitable that the close of the war would see a revival of the discussion of the proposed tunnel under the English Channel; but there is this difference between the project in pre-war and post-war days—that today it has behind it all the driving force derived from the urgent need for such a tunnel that has been revealed during the 4½ years of the great war. League of Nations or no League of Nations, it is accepted on both sides of the Channel that the construction of the tunnel would greatly strengthen the alliance between the French and British nations. Although the cross-channel service maintained by the British navy during the war was a magnificent feat of transportation, the existence of a double-track rail connection would not only have vastly facilitated the flow of troops and stores from Great Britain to France, but it would have saved enormous sums of money and much valuable time.

In all the years through which the agitation has been carried on, more or less intermittently, for the construction of this work, the scheme was handicapped, fatally handicapped, by the reluctance of the British people to permit the construction of a work which they feared would destroy their absolutely insular position. The objection was largely a sentimental one, and it has been completely obliterated by the bonds of good feeling that have been forged by the war. Furthermore, the idea that the tunnel would expose Great Britain to military invasion was largely a myth; for it would be a very simple matter in these days of high explosives and highly developed fuses and electric connections, to flood the lower reaches of the tunnel at a moment's notice, or indeed to blow it up altogether.

It has been urged that a surprise landing might be made at the terminal of the tunnel and its approaches seized and held for the passage of troops. But that would be possible only in the event of the grossest negligence on the part of the military authorities. Furthermore, it would be a simple matter to establish several secret stations along the coast and inland, at which the throw of a switch would mean the instant flooding of the tunnel.

In these days of ambitious engineering works, it is conceivable, in this connection, that the Channel tunnel might be followed by one, only a few miles greater in length, extending from the Scottish coast to the Irish coast near Belfast. Add to this a port of call on the west coast of Ireland, and the time and distance consumed in a trip from America to Europe would be very greatly reduced.

## Heat Treatment as a New Specialty

THERE was recently organized in Chicago a society whose object is to promote the arts and sciences connected with the heat treatment of steel. While the American Steel Treaters' Society is but four months old, its growth has been rapid, and a chapter has been organized in Cleveland, with a large membership. There are likewise movements on foot to organize chapters in several other large steel cities. It is encouraging to note that the comparatively new and neglected art of heat treatment is now coming into its own as a separate department of metallurgy, and as such receiving the recognition and attention it merits.

## Aeronautical

**Gothas for Great Britain.**—As soon as the circumstances permit, three of the German airplanes of each type surrendered under the terms of the armistice will be flown to England for exhibition purposes. The number of airplanes required from Germany is far from having been reached. In many cases the machines were found damaged or deficient in instruments or parts. On the British sector the proportion of large bombing planes—only about 20—left by the Germans is very small. The examination of all the planes surrendered has added to the accumulated evidence that in armament, fittings, and accessories of all kinds British aviation had completely outstripped the German air service. The total number of airplanes collected by the British Air Service is just over 500. About 170 were abandoned in open railway trucks and were left dismantled—a clear evasion of the armistice terms, and evidence of the hostile spirit in which Germany submits to the inevitable.

**Britain's Monster Dirigibles.**—An outline of the airship program which the British Admiralty are reported to have in hand indicates that the giant airships, with a gas capacity of 2,500,000 cubic feet, a lifting capacity of 60 tons, a range of 8,000 miles, and a speed of 65-70 miles an hour, will be capable of remaining in the air for a week. They have a crew of 25. Still larger airships are projected, and passenger flights are proposed for the near future. The first of these airships will be ready for launching toward the end of this year. The present record for a British airship, non-rigid, is 1,420 miles, cruised by a North Sea airship in the course of ordinary escort duty. It was in the air for two days and manned by a crew of 15. The size of these airships is comparatively small. Airships now being laid are nearly seven times as large. A number of these will probably be used for the government in experimental postal and passenger-carrying services during the coming summer. A regular airship mail service to America, during the summer of next year, is regarded as certain by airship builders.

**Big Naval Plane for Transatlantic Flight.**—There is now being rushed to completion in the Naval Factory at Philadelphia, Pa., what will no doubt be the largest airplane ever constructed in the United States. From such details as have been permitted to reach the press, it is understood that the machine will be merely an enlargement of the present Naval flying boats. It will be known as the Model T. The upper wing span will be 250 feet, which is 124 feet more than the N.C.1, the largest American plane to date. The lower wing will be 25 feet less. The length of the craft over all will be 80 feet, while the wings will be 12 feet broad and 14 feet apart. The Model T will carry five Liberty motors of 400 horse-power each, three being tractors and two pushers. This power equipment is similar to that of Lieutenant Porte's British triplane, which is equipped with Rolls-Royce engines instead of Libertys. It is predicted that the new machine will readily carry 75 passengers, making ample allowance for sufficient fuel oil and such other supplies as may be needed for a 2,000-mile flight.

**Aerial Goods Service Between England and Belgium.**—The *Daily Telegraph* of February 3d last reports that an aerial freight service is contemplated between Folkestone, England, and Ghent, Belgium. English manufacturers have been finding it next to impossible to ship goods to Belgium by ordinary transport, owing to the congestion of the docks in that country, and the Aircraft Transport and Travel Company was quick to realize the opportunity thus offered to demonstrate the possibilities of aircraft for commercial purposes. The company has entered into negotiations with British manufacturers interested in the forwarding of goods to Belgium by air. The governments of Great Britain and Belgium have been approached in the matter, and the Belgian government has already issued the special certificates necessary for this form of transport. The British Air Ministry has given its consent also to the main scheme proposed by the Aircraft Transport and Travel Company, but stipulated that pilots of the Royal Air Force shall undertake all the aerial trips made. The load carried will be about two tons of foodstuffs, clothing, and other necessities. The extension of this service to Antwerp and Brussels is planned.

## Astronomy

**Mount Wilson Observatory No Longer "Solar."**—On account of the continually increasing importance of stellar observations in its program of research, Mount Wilson Observatory has dropped the word "Solar" from its name. This step is particularly appropriate since the observatory acquired the world's most powerful telescope, which will add greatly to the number and range of night observations.

**Distances of Cepheid Variables.**—Determinations of the absolute magnitudes and parallaxes by the use of the "luminosity-period curve" of 139 Cepheid variables have recently been made by Shapley. From these measurements it appears that the distances of Cepheid variables are considerably greater than have been obtained heretofore for individual stars. Less than one-third of them have parallaxes greater than a thousandth of a second. The most distant Cepheids now known are nearly 20,000 light-years from the sun; almost as far away as the nearest of the globular clusters (about 21,000 light-years).

**Statistics of Globular Clusters.**—According to Mr. Harlow Shapley, the total number of known globular clusters is 69. Their distances from our system range from 6,500 to 67,000 parsecs, the most distant being N. G. C. 7006. The brightest stars in the most remote clusters are fainter than the 17th photographic magnitude. As to the distribution of such clusters in space, the most remarkable fact is their absence from the denser stellar regions. They are now definitely known to belong to the general galactic system. The total mass of a typical globular cluster is conservatively estimated to be from a quarter to half of a million times the solar mass.

**A Star Occulted by the Martian Atmosphere.**—An observation of extraordinary interest is reported to the British Astronomical Association by Dr. C. Moreton Olson, of Forbes, N. S. W. On April 11th, 1918, he observed with his 4½-inch refractor the occultation of the star 1524 Cape Catalogue (1900) by Mars. The unique feature of the phenomenon was that the star did not at any time pass behind the disk of the planet itself, but skirted it so closely that for five minutes the atmosphere of Mars was interposed between the star and the observer. "Throughout the star's tangential course," says Dr. Olson, "its color paled down gradually from brilliance to a very faint salmon tint; at the same time its disk enhanced in size and softened down to a blurred woolly image, as though overmagnified, or as a small object would appear out of focus."

**The Total Solar Eclipse of May 29th, 1919,** the path of which crosses South America and Africa, will be observed by two British expeditions sent out by the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies. Messrs. Crommelin and Davidson, of Greenwich Observatory, will occupy a station at Sobral, state of Ceara, Brazil, while Professor Eddington and Mr. Cottingham will observe on the Portuguese island of Principe, 110 miles from the coast of Africa. This eclipse will be notable, not only on account of the long period of totality (6 minutes, 50 seconds in mid-Atlantic and more than five minutes at the land stations), but also because of the location of the sun in a rich field of stars (the Hyades), offering a favorable opportunity for testing Einstein's theory of relativity, according to which rays coming from stars close to the sun's limb should undergo a certain deflection. A smaller deflection should also be produced by the sun's gravitation, according to current ideas concerning the nature of light. It is hoped that photographs of stars close to the sun during the eclipse, compared with photographs of the same stars in the night sky, will show whether these theoretical deflections occur. The British observers propose to concentrate their attention on the problem of getting accurate photographs with this particular object in view, and will omit the ordinary investigations of eclipse expeditions. Dr. Crommelin, who sets forth the plans of the expeditions in *Nature* (Feb. 6th, 1919), calls attention to a rather serious error in the maps of the eclipse published in the ephemerides. They indicate that the track of totality lies south of the Liberian coast; but totality will, in fact, be observable on that coast and under particularly favorable astronomical conditions, weather permitting. Unfortunately the climatic statistics for the Liberian coast are not encouraging.

## Automobile

**Capitalizing Racing Experience.**—One of the veterans of the automobile race-track has capitalized his experience by going into the manufacture of automobile tires. The racing man states that he found it necessary to make a special study of tires in order to succeed as a racer—in fact, he made it even stronger, declaring that knowledge of tires saved him from many accidents. The new tire, which is already being manufactured and sold, incorporates many qualities that have been dictated by the exigencies of racing, which brings out weaknesses and structural and other defects in tires in an amazingly short mileage.

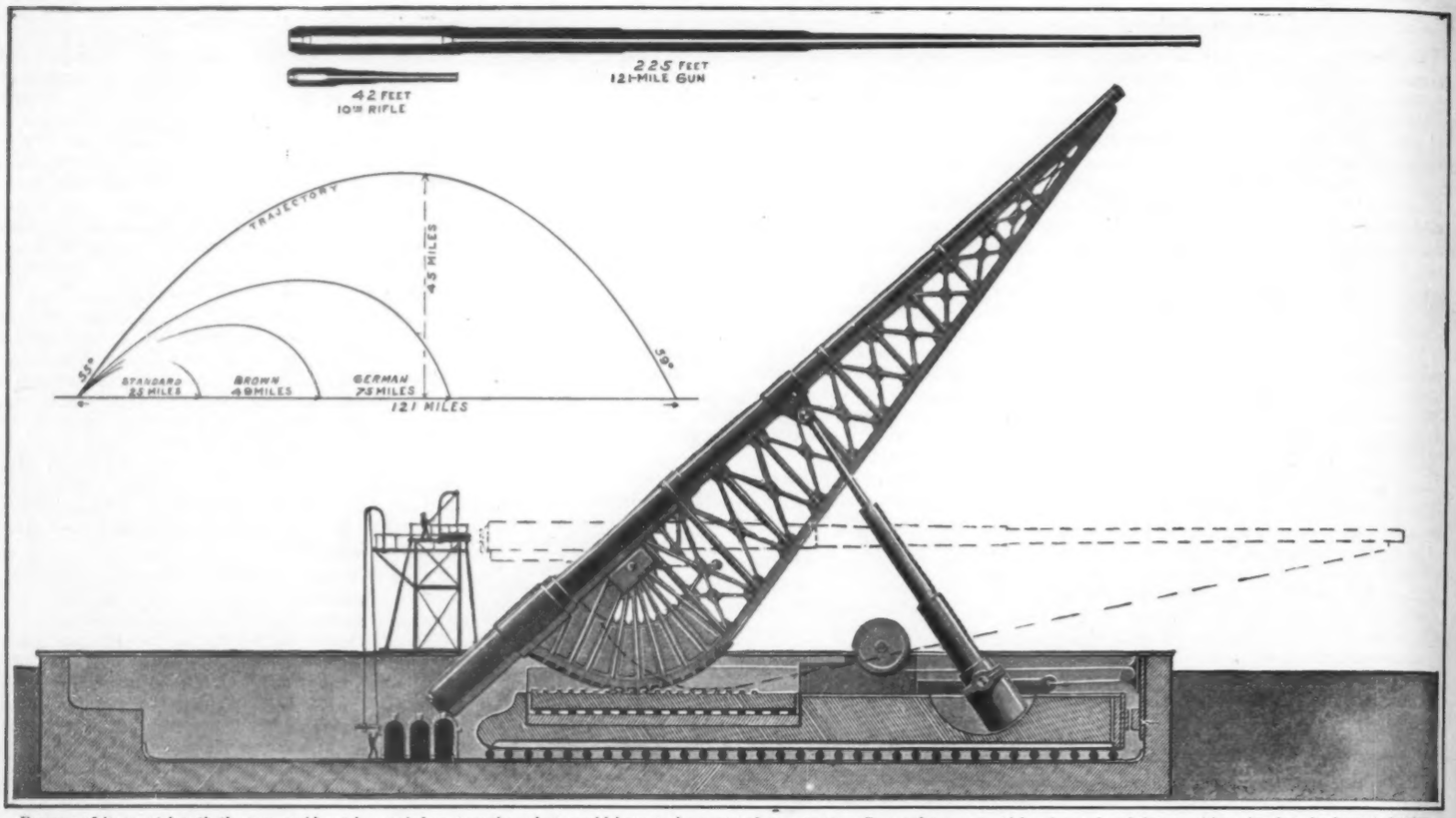
**Plans $250 Automobile.**—Again an attempt is to be made, according to well founded reports, to manufacture and market a small car to sell at considerably less than the price of any automobile now available. A manufacturer whose name is known the world over in connection with low-priced machines is said to have designed a little car and to have expressed his intention of forming a liberally capitalized company to build it. The selling price is tentatively placed at something between $250 and $350. Highly standardized quantity production methods are to be employed in the production of the proposed automobile.

**Cheap Cars for Europe.**—A French company has been formed to build low-priced cars in huge quantities in order to provide for the European market a car that will be the European equivalent of a well-known American car that is finding a large market abroad. It is said that the car, samples of which have been exhibited to interested parties, is built with European operating conditions in view and equipped with a body that suits European, and especially French, tastes. The engine is small and runs at high speed, having four cylinders $2\frac{5}{16} \times 3\frac{1}{16}$ inches. The car as a whole is said to be lighter in weight than the American machine it is intended to compete with.

**Activity in Automobile Invention.**—For obvious reasons there was little activity during the war in the development of new ideas in automobile design and construction. Now, however, the air is full of more or less substantial reports of new things that have long been simmering without an opportunity to come to the boiling point. Among the developments looked for are electric transmissions, kerosene and heavy oil engines, new ideas in the use of aluminum, tires that are puncture-proof and still resilient, simplified ignition systems, etc. As might be expected, the two-cycle engine is said to be absorbing a good deal of attention, and several new designs are to be ready in time for next year's automobile shows.

**Electrics in South Africa.**—It is an ill wind that blows nobody any good, and the ill wind of gasoline shortage has blown business in the direction of the makers of electric automobiles in South Africa. Electricity is quite reasonable in price, and the generating stations in the larger cities, such as Cape Town, Johannesburg, Durban and East London, are making special efforts and offering special rates to encourage the use of electrics. The post office in Johannesburg is using 10 trucks in the handling of mail matter with satisfactory results. Heretofore the demand for electrics has been rather small; but the new conditions that have arisen are livening up the business, the supply will be increased, and it is predicted, the prices will be lowered accordingly.

**Stimulating Automobile Buying.**—Automobile dealers have noted with considerable uneasiness a tendency on the part of the car buying public to hesitate about placing their orders, fearing that if they do so and pay current prices, there will later on be price reductions; purchasers then would be losers to the extent of the difference between the old and the new prices. The situation has been brought about by the falling of prices following the armistice and the easing up of conditions affecting the materials markets and automobile manufacturing generally. One of the most prominent manufacturers of automobiles and trucks has put into effect a plan intended to counteract reluctance to buy. If a car is purchased and at any time during the current year the price of that model is reduced, the purchaser will be refunded the difference, so that he will be in the same position as one who originally purchases at the lower price.




Because of its great length the gun could not be carried on trunnions, but would have to be mounted on a truss. Gun and truss would be elevated and depressed by adopting the bascule-bridge principle. Length of gun, 225 ft., weight 325 tons. Weight of shell, 400 pounds. Weight of powder, 1,440 pounds. Muzzle velocity, 8,500 foot-seconds. Brown gun was designed but never built.

**Theoretical study of a 10-inch gun with a range of 121.3 miles**

# A 121-Mile Gun

## Ordnance Officers of the United States Army Demonstrate Futility of Super-Range Guns

By J. Bernard Walker

LONG before the Germans began to throw shells into Paris from a distance of 75 miles, it was well understood among ordnance officers that such a feat, if any one should care to attempt it, was perfectly possible. The introduction of slow-burning, perforated powder and the great improvements in gun steel, opened up large possibilities of increasing the range of artillery, and the ranges for heavy guns, both naval and military, quickly ran up 10, 15, 20, 25 and even to 30 miles.

Because military men, in considering what range to give to their weapons, always think in terms of military objectives of limited area, such as gun-pits, crossroads, ammunition dumps, airdromes, etc., for the actual hitting of which observation from an elevated position or by airplane is necessary, no one had thought of building guns to throw shells to such distances as would prevent observation of their point of fall, and it took the German mind in its gradual ascent, or rather descent, from poison gas to submarine piracy, to conceive the idea of building a gun that could throw shells in a haphazard fashion into the city of Paris—a target so large that even from a distance of 75 miles it would be impossible to miss its most important centers. The Germans knew that the small size of the shell, 8.2 inches, and the lack of observation, would render the material damage done out of all proportion to the cost in time, money and trouble of building and operating a 75-mile gun such as they planned. It was not material, but moral damage that the Germans aimed at, and in this, as in so many other cases of terrorism on their part, they failed ignominiously.

The Allies built no super-range guns during the war—not because they were unable, but because they had no wish to. They realized, when it came to a question of retaliation for German bombing and shelling of fortified cities, that the airplane is infinitely more efficient than the super-range gun; that for the cost of one shell dropped upon a city by the gun, over one thousand times as much high explosive could be dropped from bombing airplanes, and let fall with greater accuracy.

It was in order to prove how extravagant in time, cost, and labor is a super-range gun in proportion to the damage it can do, that the Ordnance Deptmt. of the army designed a 10-inch gun, which was to have a range of between 120 and 125 miles. With a view to getting accurate data on such a gun, its design was proceeded with exactly as though it was to form the basis of working drawings and specifications for construction at the gun factory. The results of this investigation are shown in the surprising sketches and tabulated data of this gun which, by the courtesy of the Army Ordnance Deptmt., we are permitted to make public.

It should be understood, just here, that the dimensions of the gun, weight of powder, shell, gun, etc., and the general ballistic data are the result of close calculation. The method of mounting the gun, as shown in the accompanying sketch, is merely suggestive and was never worked out in any detail. Broadly stated, the problem is one of burning a sufficient amount of powder in a gun of sufficient length to maintain a mean pressure down the bore of the gun sufficient to produce, at the muzzle, the enormously high velocity necessary to carry the shell for a distance of 125 miles. With a 10-inch shell of 400 pounds weight, and a chamber pressure of 22½ tons to the square inch and a muzzle velocity of 8,500 feet per second, it was found that the angle of departure which gave the best results was 55 degrees and that under these conditions the maximum range would be 121.3 miles.

COMPARISON OF A 121-MILE GUN WITH A GUN OF STANDARD SIZE

| | Elswick Standard Gun | Theoretical Super-Range Gun |
|---|---|---|
| Caliber of gun | 10 inches | 10 inches |
| Length of gun | 42 feet | 225 feet |
| Weight of gun | 38 tons | 325 tons |
| Weight of projectile | 500 pounds | 400 pounds |
| Weight of powder charge | 200 pounds | 1,440 pounds |
| Powder chamber pressure | 40,000 lbs. per sq. in. | 45,000 lbs. per sq. in. |
| Muzzle velocity | 3,000 foot-seconds | 8,500 foot-seconds |
| Muzzle energy | 31,030 foot-tons | 201,500 foot-tons |
| Maximum range | 25 miles | 121.3 miles |
| Angle of departure | 45 degrees | 55 degrees |
| Angle of fall | 50 degrees | 59 degrees |
| Summit of trajectory | 7.8 miles | 46 miles |
| Velocity at summit | 1,550 foot-seconds | 2,600 foot-seconds |
| Terminal velocity | 1,695 foot-seconds | 2,750 foot-seconds |
| Time of flight | 1 min. 37 secs. | 4 min. 9 secs. |

An interesting fact brought out by the investigation was the determination that an angle greater than 45 degrees would give the greatest range. In previous years with guns of extreme ranges up to 21 miles, where the line of flight lay entirely in the lower and denser strata of the atmosphere, it was found that 43½ to 45 degrees was the correct angle for maximum range; but in these super-range guns, where the shell quickly passes into the higher rarified atmosphere, it was found that there is a positive gain in increasing the angle of departure, for the reason that at 55 degrees the shell follows a shorter path through the denser atmosphere, say in the first 10 miles, than it does at 45 degrees, and hence it emerges into the upper atmosphere with a higher remaining velocity.

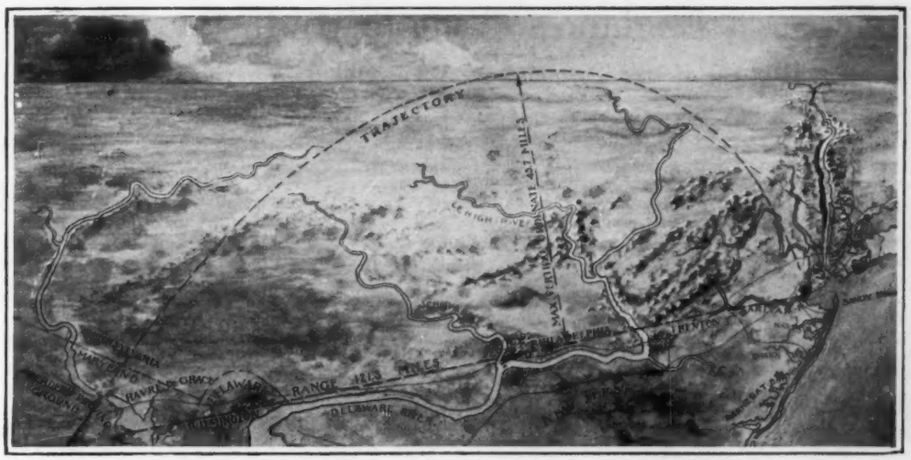
The dimensions of the gun are certainly very startling, particularly in comparison with a standard Elswick 10-inch gun. Its length is 225 feet as against 42 feet; the powder charge goes up from 200 pounds to 1,440 pounds; the powder pressure goes up from 20 to 22½ tons per square inch; the muzzle velocity, which in the standard gun is 3,000 feet per second, in the super-range gun is 8,500 feet per second; and although the shell in the standard gun is 25 per cent heavier, or 500 pounds as against 400 pounds, the muzzle energy, which is 31,000 foot-tons in the standard gun, is 201,500 foot-tons in the super-range gun.

The super-range shell is fitted with a long, tapering, false head to reduce the end-on resistance of the atmosphere, and under the enormous velocity, in a few seconds it has passed up through the 10-mile belt in which the bulk of the atmosphere is found, and sweeps with high remaining velocity into the tenuous atmosphere above. Here there is practically no retardation due to the atmosphere, and its loss of velocity is mainly due to the component of the pull of gravity acting tangentially to its path of flight. In our bird's eye view, the gun is supposed to be set up at the Aberdeen Proving Ground, about 20 miles north of Baltimore, and is aimed at Perth Amboy, opposite the southerly tip of Staten Island in New York Harbor. The shell rises steadily until it has passed over Wilmington and is within a few miles of Philadelphia, over which it passes at an elevation of 46

miles, and here it still has a remaining velocity of 2,600 feet per second. Then, as it commences to fall, gravity begins to act in its favor and probably more than counteracts the resistance of the tenuous atmosphere, with the result that its velocity increases again until it gets within ten or twelve miles of the earth, when retardation again takes place, the final arriving velocity being 2,750 feet per second and the angle of fall being 59 degrees, which is four degrees greater than the angle of departure.

The elapsed time of flight would be 4 mins. 9 seconds.

Since the total length of the gun would be 225 feet, it would have to be built in, say, four lengths, and the parts screwed together. This is perfectly feasible; in fact, gunmakers have used the method in some of their guns with complete success. The weight of the piece would be 325 tons and this, coupled with the energy of a recoil corresponding to a muzzle energy of the shell of over 200,000 foot-tons, would call for some very original and clever engineering construction in the mounting of the gun. Because of its great length and weight, it would be impossible to mount the piece on trunnions located at its center of gravity, for the gun, being elastic, would bend under its own weight and, when fired, it would have a violent whipping action. So it would have to be carried on a truss, or rather, on the apex of a triangle consisting of three trusses—two side trusses and one connecting the bottom chords of the side trusses. Elevation and depression of the gun would be accomplished by forming the bottom chord of the trusses towards the breach of the gun into two broad curved and toothed bearing surfaces, by means of which the gun and its carriage would roll upon a suitable foundation path in much the same manner as a bascule bridge. The gun truss with its counterweighting would probably be found to weigh at least twice as much as the gun, or, say, 650 tons, so that a very massive mount and powerful means of checking the recoil would be necessary. The gun carriage platform would have to be mounted upon several parallel tracks to distribute the weight, and in addition to sliding friction through blocking interposed between the under-side of the carriage and the rails, additional retardation could be provided by means of steel cables, anchored to the forward face of the gun pit, and leading back to winches on the gun platform, controlled by powerful friction brakes. The elevation and depression of the gun might be controlled by a telescoping hydraulic plunger, as indicated in our drawing.




Airplane view showing flight of 10-inch shell from Aberdeen to Perth Amboy

The thanks of the SCIENTIFIC AMERICAN are due to the Army Ordnance Department for the opportunity to present this very interesting theoretical study of the possibilities of long-range artillery. The results most dramatically prove the futility of building such ordnance. A single gun, as pointed out to us by the ordnance officer at Washington, who made the calculations for this gun, would cost probably about $2,500,000. The best it could do would be to land a 400-pound shell, containing about 60 pounds of high explosive on a target 121.3 miles away, whereas a bombing plane, costing about $30,000 would land a 1,600-pound bomb on the same point with greater accuracy of aim.

## Operating Room That Flies to the Battlefield

By F. Honoré

THERE is nothing new in winged ambulances, which serve to transport wounded soldiers from the battlefield to the base hospital some distance away, with the minimum of discomfort and loss of time. But there is distinct novelty in the winged operating room or surgical ward, which flies to the battlefield and performs its work where its patients have fallen. Especially in cases of severely-wounded soldiers, wherein operations must be immediately performed if a life is to be saved, is the surgical airplane indispensable.

It has remained for a French doctor, Vilmant, and a Russian engineer, Nemizovsky, to introduce the surgical airplane or winged operating room, which flies to the battlefield where severely wounded men are in need of surgical aid, with its staff of surgeon and assistants and complete equipment. The winged operating room or surgical airplane, the first example of which was officially tested at Paris on March 3d last, is of the biplane type and generally a slightly altered bombing plane, such as the Voisin. The first machine of this type has a useful load capacity of 750 kilos (1,650 pounds), which is utilized for the pilot, surgeon, the assistant surgeon, a complete X-ray equipment and a complete set of surgical instruments and accessories, including a combined X-ray and operating table, sterilizing outfit, instrument cabinets, medicine chests, and so on. Current for the X-ray apparatus is supplied by a storage battery which is charged while the biplane is under way, by means of the usual air-driven generator.

Near view of the Voisin surgical plane, showing the stream-lined compartments for carrying the equipment

Surgical airplane that carries a surgeon and assistant, and complete operating room equipment here shown

Needless to state, all the equipment has been designed with a view to economizing weight and space. Aluminum has been used to a great extent, as can well be imagined. Many of the pieces of equipment can be more or less completely dismantled. In the close-up view of the airplane, it will be noted that the equipment is carried in long, stream-lined bodies underneath the wings and to either side of the nacelle, as well as in the nacelle.

At present, M. Nemizovsky is engaged in constructing a still larger surgical airplane which is destined to serve as an operating room on the battlefield as well as a means for transporting the wounded. This machine will carry seven or eight surgeons and assistants with their equipment, who will be installed at some convenient point on the battlefield. The airplane will then be available for transporting the less seriously wounded soldiers to the base hospital.

## Some Applications of Electroplating

ELECTROPLATING is an art which has been developed during the last 50 years with only occasional applications of scientific principles. Formerly the industry was much shrouded in mystery, each plater guarding jealously the formulas and methods employed by him. Of recent years, however, there has been a considerable demand from electroplaters and manufacturers for more exact data relating to this industry.

This need and demand for information has been emphasized during the war by the numerous problems that have arisen in connection with the plating of military supplies of the most varied description. Thus, zinc plating has furnished an excellent and, in many cases, the best protection against the corrosion of steel parts, such as airplane and seaplane fittings, fuse parts, hardware on ammunition boxes, etc. Black nickel plating was very extensively used for producing the so-called "government bronze" finish upon brass hardware and saddlery equipment. Lead plating proved valuable in the lining of gas shells and for bringing up to standard weight shells which were underweight. In connection with these problems a number of investigations were conducted at the Bureau of Standards, whose experts made frequent visits to munitions plants to advise upon the best methods of securing the desired results.

Appropriations have been requested by the Department of Commerce to permit more exhaustive study by the Bureau of Standards of plating problems and their application to various manufacturing industries. Electroplating forms an excellent illustration of a "key industry"; *i. e.*, an industry which, while it is not itself of great magnitude, is often of fundamental importance to larger industries. Thus, electroplating is essential to the manufacture of tools, builders' and saddlery hardware, plumbers' supplies, gas and electrical appliances, automobiles, silverware, jewelry, stoves, household utensils, mechanical devices, such as phonographs, cash registers, sewing machines, adding machines, typewriters, cameras, and other optical and scientific instruments, and, in fact, almost every industry in which finished metal articles of any description are produced. Progress in the art of electroplating will bring about corresponding improvements in all such industries.

Arrangements have been made by the Bureau of Standards to secure, by inquiries addressed to the platers of this country reliable information regarding kinds and methods of plating now in commercial use.

# England's Aircraft Industry

## A Glimpse of Her Tremendous Achievement from Small Beginnings

By C. H. Claudy, Special Correspondent of the SCIENTIFIC AMERICAN, Now in London

WHEN the war started, Great Britain sent 66 airplanes to France. No one knew, then, what airplanes were to be in the war, still less that they were to be the deciding factor. At the same time France had about 140 machines in the air, but they accompanied a much larger army than Great Britain's first 150,000 expeditionary force.

When the United States came into the war, we promised, rather too rashly, to produce some 20,000 planes, perhaps in a year, but certainly within two years.

We didn't do it. Great Britain made no promises, but what she did, though apparently little known, is far more than we promised to do.

At the beginning of the war Great Britain's capacity for manufacturing airplanes was not greater than 100 per year. At the time the armistice was signed she was turning out planes at the rate of 800 a week! In other words, her production possibilities were demonstrated to be in excess of 40,000 planes a year! Think of that, and remember that it is not America, with her limitless resources of men and money and factory and raw material but the British Isles, with their very much limited man-power, material resource and steel industry, which not only built the planes but engined them. And then, as do all other fair-minded Americans who get the actual facts, take off your hat and bow in deep respect to a nation we of America are rather too apt to consider slow and old-fashioned in methods when it comes to factory production.

Nor think for a moment, "Oh, well, after all, they were only *British* planes and engines." The "only" doesn't sit well, when it is known that in speed, power, climbing ability, maneuverability, steadiness and sturdiness, the British planes led those even of France, home of aviation. As for Germany's much vaunted planes, while it is freely admitted that it was Germany which first armed a plane with a rapid-fire gun shooting through the propeller, a move which gave the Allies serious trouble in 1915, her craft, as craft, were never in the same class with the British fighters; only history and the perspective of years will tell how much of the war was won in the air, but all the facts of both quantity production and ability to stand up under gruelling work are on the side of the British machine.

It is difficult to give an idea of the size of the industry as it is—figures mean so little to the average reader, and yet figures and only figures can tell the story adequately. In 1914 there were six factories in England turning out aircraft. There were 126 firms under contract for planes, besides three huge royal aircraft factories at work here when the armistice was signed. And they *produced* planes!

In the year 1918—and please recall that the armistice was signed on the 11th of November—England turned out no less than 30,849 airplanes of all types. And they were all engined—not, it is true, all by home manufacture, but they were all engined. Indeed the available engines exceeded the planes, there having been 31,021 engines available from all sources!

Lest some one with a vivid imagination and an intense patriotism imagine that the Liberty motor played any very important part in this engining campaign, let it be stated that Liberty motor deliveries to England commenced in May, that the promises ran from 20 in May to 100 in June, 200 in July, 400 in August, 500 in September, 315 in October and 316 in November, while deliveries commenced with 34 in May, and then ran 50, 125, 56, 336, 92, 130, and a final delivery of 132 in December. In other words, we promised 1,851 by November and delivered 1,255 by December.

And this was one engine—a very fine engine, an engine given the highest praise in England, both for its performance and for the marvel of its having been designed and put into production so soon and so rapidly. But if England cared to, she could make considerable fuss about her own ability to produce engines! It must never be forgotten that England did not recognize, any more than did the rest of the world, that the war was to be largely won in the air, until the war was well along into its four years of life. By the time she was ready to realize that there must be planes, and planes and still more planes, and that planes meant engines and that engines meant, first of all, steel, the munitions industry had stepped in and grabbed most of the available steel and had it all promised for other things. Yet at this point Great Britain developed a new steel industry to feed her engine factories, and was making more than she needed when the armistice ended the necessity.

The total number of airplane engines delivered by British contractors during 1918 was 21,950. This number includes 23 different varieties, made in quantities ranging from eight to 4,064. It is not necessary to mention them all; but it is interesting to see them divided into classes. Of two types of vertical engines 5,370 were made. Of the V-type motors, there were 12 makes, produced to the tune of 9,049. Two makes of radial engines—similar in appearance to rotaries, but with the cylinders stationary—were made in quantities aggregating 36. Finally there were 7,504 specimens of seven brands of rotary engine.

It is interesting to follow the monthly production of engines in the light of history. In January the total production of all makes was 1,664. February saw 1,428 manufactured, and March 1,731. In March was the great German offensive, it will be remembered, and of course all production was speeded up. But it takes time to speed up production of engines. So April saw 1,667, May 2,039, June 1,760 and July 1,983. In August they drew breath and turned out only 1,528 but by September and October production was going on like lightning, 2,387 and 2,845 engines coming forth ready to fight the Hun. Then came November and the armistice and production dropped to 1,615, followed by December with 1,303.

The production of planes, of course, exceeded the production of engines. Partly this is due to the smashing of planes, which does not always smash the engine, and partly to the fact that it is easier to make a plane than an engine, battleplanes perhaps excepted. But there were always enough engines when the foreign sources were added in with the local production.

It must not be forgotten that there are two sides to the air service and that the naval side was of very great importance. Thus, there were made during 1918, in addition to the 30,000 odd aircraft already mentioned, no less than 1,407 seaplanes, which number includes flying boats. Not until the British Admiralty chooses to unlock its lips will the story of Britain's navy in the air be known, but it is a strange story, judging from the straws which stick out here and there, one worth telling and worth hearing.

A little sidelight on aviation in general is thrown by the propeller statistics. England produced in 1918 no less than 80,446 propellers, which is very nearly three propellers for each plane! This figure by the way, is for 11 months only, December statistics not being available. Evidently the mortality among propellers is no less on this side of the Atlantic than in the United States. The largest month was October with 11,123 propellers—nearly 400 daily.

Some factory statistics may make the picture a little clearer. In one shop, for instance, where Handley-Page machines are made—the great big machines which carry so much weight, either in passengers or in bombs—there is employed an average of 1,600 people, of whom 400 are women. During May, June, July, August, September and October of this year this particular factory put out 25, 23, 23, 27, 21 and 18 machines. It required 16,770 man-hours per machine in this shop, plus about 50 per cent to be aded on account of work done on sub-contracts, to complete one of these huge monsters.

The smaller machines, of course, did not take nearly so long to complete. A shop devoted to the manufacture of the familiar Sopwith Camel turned out 60, 40, 34, 36, 35 and 47 machines during the months mentioned. There are employed here an average of 650 people, of whom from a third to a half are women. The man-hours required for one of these machines is but 435, which is surely rushing it through—43 ten-hour days for one man to make a plane!

It may be interesting to note the size of such a factory. This particular Camel factory has devoted to mill work 8,134 square feet, to joiners shop 25,721 square feet, to dope and fabric shops 9,034 square feet and to the main erecting shop 14,436 square feet of space. In a contract factory devoted to making D. H. nines, there were turned out finished planes at the rate of 147, 145, 173, 94, 88 and 195 in the months from May to October inclusive. Here there were in the neighborhood of 2,000 men and half that number of women employed. The man-hours per machine were 4,535, to which some 15 per cent must be added for the contract work done in other shops to complete the plane. The size of this factory is shown in the floor space used, 9,450 square feet in the sawing shop, 57,000 square feet in the joinery shop and 150,000 square feet in the main erecting shops.

Altogether Great Britain manufactured more than 50,000 planes in 1916, 1917 and 1918. Had the war continued much longer, she might have rivaled our own Liberty in engine production as the big Napier Lion was just coming into production. It is a 12-cylinder, 2,150-revolutions-per-minute engine which develops about 480 horse-power. In this connection it is interesting to note the universal experience here as between the production engine and the hand-made engine. There is no question but that the production engine can be made so that the total output vastly outdoes the life of the total output of the hand-made engine with the same man-hours per engine. But there is also no doubt that engine for engine, the best production engine is inferior to the hand-made engine in lasting qualities, in an average ratio stated with diffidence, by many who should know the exact figures, to be two to three. That is, if the life of the hand-made engine is 120 air-hours that of the production engine will be but 80 hours. So much for the thoroughness and care of British machinists' labor!

But when all is said and done, there is no real exaltation in figures, and no enthusiasm in statistics. Grant that more machines came from less floor space and less man-hours here than anywhere else—which may or may not be the case—and what is there in the statement after all? The big picture is in the fact that with 66 planes going to France with the first expeditionary force, with a yearly capacity of 100 machines and those by no means remarkable for speed, power, endurance or climbing ability, Great Britain has, within three years, put her airplane industry in the front rank of those of the world, supplied herself and her allies, and our own troops very largely, with planes produced, and procured engines enough to pull through the air the stupendous production of more than 30,000 planes yearly, and was going at the rate of over 40,000 planes yearly when the armistice came through!

What she will do with her airplane capacity only the future can show. But for the present, both in planes existing—a figure which unfortunately cannot be had—and in plane-production power, Great Britain is as much mistress of the air as she is mistress of the seas. And she did it all in less than three years.

### Ships of "Puffed Brick"

THE world was skeptical when engineers announced as a win-the-war measure that they would build sea-going concrete ships. Who ever heard of a rock floating, anyway? The same sort of talk confronted the man who made the locomotive. He was told the wheels would simply spin and that there would be no traction. But the locomotive walked away with itself and its load, just as the concrete ship floated as gracefully as a swan.

But when the engineers tell us they are building a ship of "puffed brick" they are carrying things, it would seem, to a foolish extreme. Yet this is what marine engineers are doing out on the Pacific coast. Two puffed-brick ships are soon to be launched at San Francisco. Bricklayers are not, however, employed in building this peculiar type of boat, because with the mortar used, a trowel-wielding laborer is not required.

The "puffed brick" used is made, like ordinary brick, of a peculiar clay containing a low percentage of silica. Subjected to an intense heat, the brick puffs up like popcorn. The product looks something similar to coke and is about as light. Once puffed the bricks are ground to a dust and mixed with cement. This process, it is claimed, makes for a gain of about 40 per cent in the lightness of the ship's walls, without losing any of its strength.

The ship's forms are built in standardized sections and are hinged with bolts so they can be forced up and put out of the way when the concrete hardens. After launching, the forms are quickly put back into place, steel reinforcing rods installed, and the pouring of another ship can be begun.

According to experts in concrete shipbuilding this system makes it possible to turn out a 7,500 ton-vessel every three months, and only about 25 per cent of the lumber in the forms is wasted. The first two ships built of this material at San Francisco, each 7,500-ton oil tanks, are ready to be launched. They resemble steel ships in their lines and are a big improvement over the "Faith," the first concrete ship built. They are to be launched broadside to the water, as this method spreads the strain over a larger surface.

# The Chemical Foundation

## A Semi-Official Corporation that Will Hold the Fort Against German Reinvasion of Our Chemical Industries

WHEN the Alien Property Custodian began taking over the business of German chemical houses in this country, he found himself confronted by a curious situation. The Trading with the Enemy Act had not in the first place been so drawn as to make it possible for the Custodian to take over enemy owned patents: and if he were to attempt the operation or the sale for operation of the seized plants, he would be laying the foundations for much future litigation and possible heavy damages to the owners of such patents. For in the eyes of the law one who uses a patent without the consent of the owner is an infringer, whatever the circumstances; patents are not granted with the reservation that they become invalid in the event of the war.

An amendment of November 4th to the Trading with the Enemy Act was designed to remedy this defect in the original law. Under its terms patents were included among the enemy property which might be seized and held by the Custodian; and it at once became possible for him to operate patents himself and to license their operation by others, either exclusively or otherwise. But on careful consideration of the matter, Mr. Palmer, then holding the office of Alien Property Custodian, decided that there was far more promise even than this in the new situation.

It seemed, in fact, that the seized patents might afford a possible solution for the problem, theretofore unsolvable, of protecting the new American dye industry against German competition after the war. It was evident from the manner in which the German chemical concerns had done their business that they had no intention of manufacturing in this country, and did not fear competition from American manufacturers, and that accordingly they could not have taken out American patents with any idea of preventing American competition. This being the case, they must have taken out these patents as protection against competition in the American market by other European manufacturers. If they were sufficient to stop importation of competing Swiss, French and English dyes, they would presumably serve, in American hands, to stop equally the importation of German dyes. This was particularly probable in the case of the product patents, since most of the coal-tar dyestuffs are definite chemical combinations to which a product patent is entirely applicable.

The idea was accordingly conceived that if the German chemical patents could be placed in the hands of any American institution strong enough to protect them, a real obstacle might be opposed to German importations after the war, and at the same time the American industry might be freed from the prohibition enforced by the patents against manufacture. So a corporation has been organized, to be known as Chemical Foundation, Inc., in which practically every American manufacturer will be a stockholder, but in which the number of voting shares held by any one interest will be so restricted that improper control will be impossible. This Foundation will hold the German chemical patents, some 4,500 in number, which have already been transferred to it for a consideration of $250,000. It will in no case operate any patent itself; it will merely act as a holding and licensing body. Nonexclusive licenses only will be granted to all proper American applicants at a small fee, and to the United States without fee. All surplus income is to be used for the retirement of the preferred (non-voting) stock, and thereafter for research work looking toward the advancement of chemical and allied science and industry. In this work the Foundation will have the coöperation, and above all the use of the equipment, of the Bureau of Standards and various other public and private research organizations.

The capitalization of the Foundation is half a million dollars, of which $100,000 is voting common stock and the balance preferred stock. After paying for the patents transferred to it by the Alien Property Custodian, it will have $250,000 working capital; and it will accordingly be in a position to prosecute vigorously any infringement proceedings which may become in order when German manufacturers begin their attempts to regain their American markets.

The price paid for the patents which constitute the stock in trade of the new concern was necessarily somewhat arbitrary. The great majority of the patents, presumably, are valueless. Of the remainder the value was quite impossible to estimate. Substantially the entire American dye and medicinal industries having combined in the procurement of the capital for this undertaking, it would have been impossible, on public sale, to find as a bidder any legitimate manufacturer—any bid received would necessarily have been from speculators with intentions amounting to blackmail, or actually acting in the interests of the former owners. So the sale of the patents was made privately, and at the figure mentioned, which represents merely somebody's guess as to what the patents are worth, but which, no matter how wrong it may turn out to have been, can injure no one, but will serve as a basis from which the Foundation can begin operations.

In a comprehensive report covering the matter of German chemical patents, Mr. Palmer, the outgoing Alien Property Custodian, explains very fully the manner in which Germany had secured her world monopoly in the chemical field, the necessity for breaking that monopoly, and the official expectations that this Foundation will constitute a very potent means toward that end. In a later issue we shall present some of this interesting material to our readers; for the present we have space merely for this account of the remedy which has just been put into operation. The new institution promises an incalculable benefit not only to the dye and chemical industries, but to the whole American manufacturing world. The opportunities which it can offer and the rewards which it can hold out to competent research scientists should far exceed those of any institution unconnected with industry; and it may well, therefore, form the nucleus of the greatest research organization in this country.

# Correspondence

**The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.**

### A New Plan for Daylight Saving

To the Editor of the SCIENTIFIC AMERICAN:

The plan of setting the clock back one hour in order to save the daylight of summer takes advantage of part of the wasted daylight, but does not begin to be efficient in this respect. The sudden change of one hour in time is always attended with confusion and discomfort. The following plan will utilize all of wasted daylight and will avoid confusion consequent on a sudden arbitrary change of one hour in the time.

The difference in time between sunrise on the 22d of December and sunrise on the 22d of June is approximately three hours or about thirty seconds a day. The beginning of the working day is now fixed with regard to the middle of the day. In order to use the daylight hours effectively the time of sunrise should be the beginning of the day instead of the greatest meridian height. Therefore a plan by which the beginning of the working day is changed automatically with the change of sunrise will afford the greatest efficiency in saving daylight. This can be accomplished in a very simple manner.

The Western Union, through its electric clocks gives official time throughout the country. This official time could be easily changed during six months of the year by regulating these clocks to make them lose two seconds or more each hour or sixty seconds a day. The watches and clocks of the country can easily be adjusted to run thirty seconds fast during the other six months. Eight o'clock is probably the most popular time the country over for beginning the day's work. The ideal sunrise time would probably be seven o'clock, since when the sun rises at seven there is usually sufficient light for ordinary purposes by 6.30 which would perhaps be early enough for the rising time of most of the people. This plan would, therefore, best be put in operation at the time when the sunrise is at seven o'clock which would be about the first of February. The people would then continue to rise with the coming of the light the year 'round and it would be done automatically. Having once adjusted time-pieces people would not realize on the 22d of June that they were rising three hours earlier than they were accustomed to rise the year before.

On the 22d of June the time-pieces would be reversed and the master clocks would gain 30 seconds a day for six months and without knowing it people would by the next February be rising three hours later.

HALSEY W. WILSON.

New York City.

### A Camera for Filming Rapidly-Moving Objects

THE conventional motion-picture camera is excellent enough for the regular run of film work. It can be focused by estimating the distance and then setting the lens according to a scale, or, for more accurate work, the image can be focused by looking through a peephole and on to the film, which acts in the same manner as the ground glass of the plate camera. And when it is necessary to follow a moving object, the camera can be traversed and tilted by means of two handles actuating the tripod head.

However, the conventional camera has its limitations, particularly in unusual film work such as may be encountered in screen reporting and travel subjects. In fact, while doing extensive scientific work in the jungles of Africa, Carl E. Akeley of the staff of the New York Museum of Natural History, found the usual type of motion-picture camera inadequate and unreliable for the varied uses of field work. Knowing the demands of the topical and scenic camerman, he conceived the principle of the present camera which bears his name. Upon his return to the United States he designed and executed the first working model, which was described in these columns almost three years ago.

And when the Signal Corps of the United States Army embarked on the gigantic task of filming our part in the war, the authorities settled their choice on the Akeley camera because it met their requirements better than any existing camera. The fact is that the Akeley camera is totally different from any other camera, and that is why it is available for special work which can hardly be undertaken with the average camera.

Briefly, the Akeley camera is a one-man camera, in the sense that its operator can carry the camera, magazines, and tripod himself, and set them up without assistance. The Akeley tripod is of the truss design, with the members locking by means of eccentric clamps. The legs are placed in any convenient position, and pulled out to any length desired, whereupon they are immediately locked in position by pulling up the eccentric clamps. The camera is then leveled by means of the ball-and-socket joint and a spirit level. All in all, this tripod mounting is absolutely rigid.

The tripod head in this instance does not call for the usual cranks for the panoramic and tilting movements. Instead, the camera is controlled by a short lever which protrudes at a 45-degree upward angle from the rear of the case. By applying pressure on this lever, the camera can be moved horizontally or vertically, or both horizontally and vertically at the same time. A steady movement is assured by gears and flywheel, and a releasing device permits the camera to be quickly moved if following an exceptionally fast object. The horizontal panoramic movement permits of a complete circle, while the vertical tilt allows of a 140-degree range, pointing from the ground to directly overhead without changing the tripod or tripod head. Still another feature is the fact that the camera may be removed from the tripod, while still retaining the tripod head and three-point support for use on a table, log, rock, or other surface.

Twin lenses are employed on the Akeley camera, one for the film and the other for the finder. This arrangement permits of watching the picture on the ground glass, right side up, while operating the camera. Again, the eyepiece always remains in the desired position, no matter how the camera may be tilted, because of a double prism system of transmitting the image through the hinged tube. Thus the operator can always tell whether his picture is in focus—indeed, he sees exactly what the film is recording at all times.

The shutter of this camera is in the form of a continuous fabric belt, containing a variable opening. This belt travels between the double walls of the camera case. Its opening can be adjusted for any size, so as to vary the length of exposure. In fact, it is a focal-plane shutter quite similar to those employed with reflecting-type cameras. The movement is also unique, being of the single-pin design. The magazines are made in one unit, and are always ready with a short loop for insertion in the camera mechanism. This permits the camera to be reloaded and threaded in from 10 to 20 seconds. Complete, the camera weighs 43 pounds.

For filming rapidly moving objects, such as motor boats, airplanes, athletes, and so on, there can be no doubt that the Akeley camera is in a field by itself. And this is but logical, since it was designed primarily for that purpose by a man in need of such equipment.

# Return of the 17-Year Locust

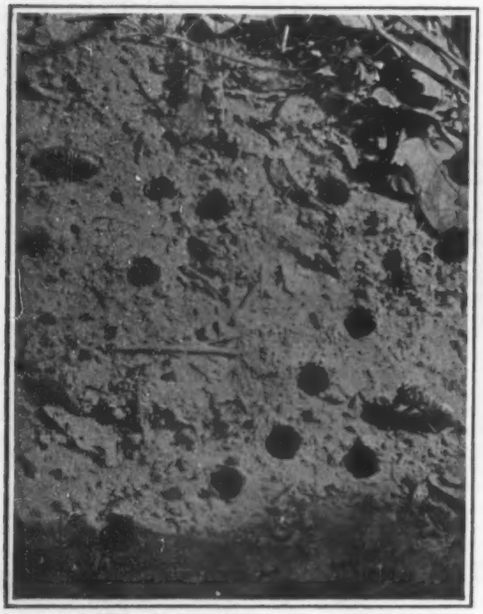
## What He Is and How to Combat His Ravages

By W. H. Ballou, Sc.D.

THE Department of Agriculture, Washington, warns that this will be one of the worst seasons on record for ravages by the Seventeen-Year locust. Government entomologists predict that "the variety is due to swarm in large numbers."

Somehow the idea is broadcast that the country is visited by this variety of locusts only once in 17 years. This version has no application. The insect derives its common name merely because of the fact that it requires a full-fledged locust 17 years to mature from the egg through its several stages. It is quite possible for the variety to be busy somewhere every year. I note the following label on the economic display of the insect at the American Museum of Natural History, New York:

"The 17-Year Cicada, *Tibicina septemdecim*, appears in the late May or early June of a locust year. The immature cicadas crawl out and ascend tree trunks or other vertical surfaces. If the ground is dry or bare, they make a circular opening only; if moist or covered with leaves, a mud tower is built around the hole from which they emerged. These towers are frequently made by the immature cicadas several weeks before they are ready to leave the ground. Within a few hours after reaching a suitable resting place, the skin splits along the middle of the back and the adult emerges. Later,



**Locusts emerging from the 16-year sojourn in the ground**

the female deposits her eggs in a succession of slits in the terminal twigs and slender branches of many kinds of trees and shrubs. About 15 eggs are placed in each slit. The branches thus punctured frequently break off and die. The well known song is produced by the male only. In the late season, the insects are attacked by the lower fungus, *Masospora cicadina*, developing in the abdomen. It causes the posterior abdominal ribs of the insect to fall away."

The following up-to-date statement on this destructive insect is noted in "Field Book of Insects," just off the press, by Dr. Frank E. Lutz, Associate Curator of Entomology of the American Museum.

"The 17-Year Locust, as a matter of fact, is a 13-year locust in the South. The adult is of the same general shape as its relatives, except that its eyes and the principal veins of its wings are red. There is nothing mystical in this color or in the 'W' on its wings, although the sudden appearance of the adults in large numbers has been supposed to foretell war. For about 16 years in the North, the young suck at the roots of plants. Toward the end of this period scale-like rudiments of wings appear. In the spring of the 17th year, the nymph makes its way to the surface of the ground by a smooth, firm funnel. From late May to early July, it and other members of its brood crawl out singly or in droves to some support, the adults having a week or so of aerial life to recompense them for the long period of preparation. There are a score or more of different broods, each of which has a rather definite—often restricted—distribution and time of emergence from the ground. Suppose there are three such broods in your neighborhood. One of them, the adults, may have appeared in 1911; its next appearance would be in 1928. Another might be 1916-1933, and so on, while a third might be 1919-1936. As a matter of fact, these are actual brood dates, although they may not be the ones in your neighborhood. Hence we may have 17-year locusts oftener than every 17 years, to say nothing of the possibility of laggards or extra spry individuals, in the various broods, which do not appear on schedule time.

"There are numerous other species of this family. It might be noted that the name *Cicada tibicen* of many books, as applied to one of our harvest flies is an error, probably being a tropical species. The differentiation of species is largely based on the form of the male genital plates, although there are size and color differences. An attentive ear can detect differences in song. Of the genus *Cicada* as now limited, the small species, *hieroglyphica*, with an almost transparent abdomen, may be found in pine barrens, and is our only species. *Tibicen sayi*, fairly typical of its genus, is the common one of our region. The somewhat similar *Okanagana* is more common in the West than the East." In addition, it may be stated that the 17-year locust has been removed by Lutz from the genus Cicada and placed in the genus Tibicina, where it belongs by right of priority. He continues:

"The Cicadae are known as cicadas, harvest flies and locusts. The eggs are laid on twigs. The newly

**The protective pyramids of earth made by the locusts as they come to the surface**

hatched young drops to the ground and burrowing into it, feeds by sucking the juices of roots. It lives in this way for some time, the length depending on the species, its appearance changing but slightly. Finally, it digs out by means of its enlarged front feet, crawls on a tree trunk or some such thing, splits down the back and liberates the adult. The adult male 'sings,' often very loudly and shrilly, by vibrating membranes stretched over a pair of sound chambers, situated, one on each side, near the base of the abdomen."

Interesting as the career of a locust may be, it is as nothing to the tragedy in nature of its extermination, after it has had the termerity to leave Mother Earth, dry in the sun and deposit its eggs. This extermination is brought about in the adults by a lower fungus which commences to breed in its body during hot weather. This fungus belongs to one of the most peculiar groups called *Entomophthoracene*, because they are minute parasites which inhabit bodies of small flies and other insects. They are distinguished by the production of numerous hyphae, or tubes which enclose essential protoplasm. The hyphae of insect-destroying fungi are of large diameter and fatty contents, ultimately emerging from the host in white masses of peculiar appearance. They produce at their extremities large conidial or sexless spores, which are violently discharged into the air and propagate the disease. In addition to these conidia, the propagation of the fungus, after long periods of rest, may be provided for by the formation of thick walled resting spores, adapted to withstand successfully the most unfavorable conditions. Resting spores also may be either sexual or asexual. In either case they finally germinate and produce conidia in the locust that are discharged in the usual fashion, when they infest fresh hosts. Locusts, flies and other insects greedily eat these spores, thereby becoming infected and later destroyed as the fungus spreads through the body, absorbing all its edible contents for its own use.

The hypothesis of infection of insects by contact with one of the conidia, while possible, is altogether improbable and not within actual recorded observation. Insects are notorious eaters of the spores of fungi. The larvae of insects, feeding on a fungus, likewise absorb the spores. A fungus spore is endowed with the diabolical ability to travel in a myriad ways through the varied elements, air, water, etc., to retain its germinating power under nearly all conditions for an indefinite period of time, to lodge on a weak spot of its own type of host, to cling there and breed whenever, later, oxygen and temperature and moisture are agreeable to it. The fungus, however minute, grows larger and larger on the host's food, while the host grows thinner and thinner, until its vital organs are destroyed. The house of the locust or other insect is largely constructed of chitin, which no known fungus can utilize as food, and so it too must demise when its host can no longer provide food for it.

The time to destroy 17-year locusts is while they are

**Locusts drying out on a pine tree after emergence**

on the bark of trees and shrubs, drying out, a period of perhaps 10 days. Use an insecticide then or any other convenient means and kill them. Otherwise, the females as soon as they get strength, will leave the bark and proceed to lay their eggs on leaves and twigs, destroying the foliage, later to roam with the males, destroying crops of whatever is to them edible. It is better to pick the locusts off the trees by hand, however slow and arduous the process, and destroy them by burning or in buckets of water, rather than leave them unmolested because of the expense and time. Insecticides are purchasable in stores, or they may be made at home from recipes which may be had on application to the Department of Agriculture, Washington.

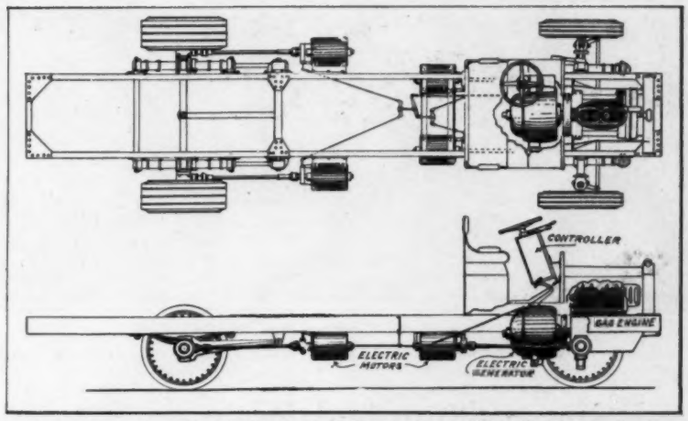
### Mountain Side Moving

SUBSIDENCE causing serious damage to property has taken place at the Welsh village of Victoria. It is attributed to a mountain slip, and to settlement of the soil due to underground workings and the recent heavy rains. The whole mountain side seems to be moving. In some streets the pavements have been ripped up, and the roads have collapsed, in one instance dropping several feet. Two or three buildings fell, and house fronts have cracked. At last accounts, the damage, which is on the increase at a rapid rate, extends to 30 houses and is estimated at over $70,000.

## A Novel Electrical Control for a Train of Motor Trucks or Other Vehicles

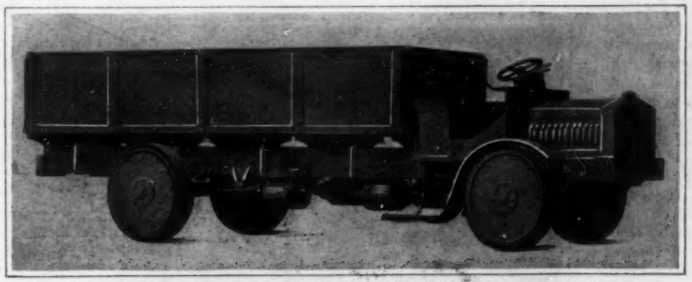
THE handling of a train of motor trucks or other moving vehicles over ordinary streets, roads, rails, or water, has been simplified of late by a new control system. Indeed, this control system has wide possibilities especially in converting our present excellent highways into real traffic arteries; for, instead of single trucks, and trucks and single trailers, this system makes possible the handling of long trains of many units, with the same facility as the single truck of the present day.

The newly-introduced system of electrical generation, control, and distribution is the invention of Rodolphus Fuller, a mechanical and electrical engineer of Detroit, Mich. It is said to differ from all other known systems of electrical control heretofore used on self-propelled vehicles. In the general application the system of Mr. Fuller uses four series-wound motors for vehicle work, each motor driving an individual wheel. The series field windings of the generator—for this system is a gasoline-electric one in the case of a motor truck—are multiple compound, and the electrical controller in conjunction with the electrical generator is the main feature of the entire system. This controller will operate any number of motors in series, in series parallel, and in parallel. This arrangement gives quick acceleration with high power to overcome initial torque. Any number of motors from a single motor to any multiple of motors may be operated for any purpose whatsoever, with this system.




Two views of an electrically-controlled motor truck driven by four motors

The control system does away with the use of all resistance in the main line circuit from the source of generation to the motors performing the work. The system does not use resistance devices to prevent too great a rush of current to the motors when starting a vehicle from rest to acceleration. The electric generator always delivers a gradually increasing voltage from rest to full acceleration, instead of starting with full votage in the circuit. In other words, the voltage is generated from zero volts to full electromotive force, which keeps the generator electromotive force higher than the counter-electromotive force of the electric motors operating the vehicle.



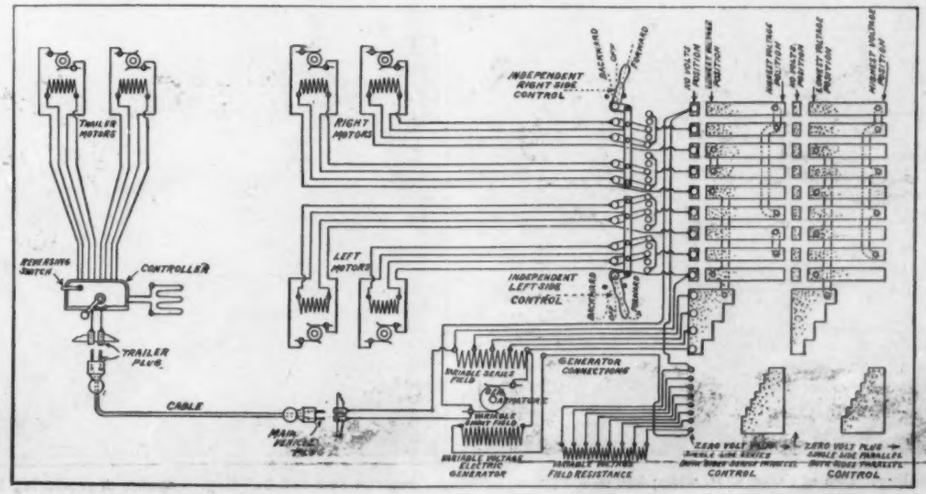
Gasoline-electric motor truck equipped with a driving motor for each wheel

By referring to the accompanying wiring diagram, it will be noted that the generator series windings are divided into eight sets of coils. Any number of coils may be used. In the first position of the controller handle, the current does not pass through the field winding. It short circuits across the field winding. The four motors are in circuit with themselves and the armatures of the generator. A small amount of current goes through the shunt field windings, also a small amount through the series windings, but not enough perceptibly to raise the voltage in the circuit above what might be called zero voltage. When the controller handle is moved to the next notch, the first contact finger slips off contact and the current, after it leaves the generator armature, passes through the first set of series field coils, resulting in a rise in voltage. A movement of the controller handle to the next notch passes the current through two sets of series field coils, again increasing the voltage. The movement of the controller is continued in a similar manner until the eight sets of series field coils are active and the voltage is increased to approximately 25 per cent of the maximum voltage of the generator. During this time the shunt field windings have been inoperative.

At this point the shunt field rheostat becomes operative, increasing the electromotive force to its maximum for the full acceleration of the vehicle. It is obvious from what has already been stated, that Mr. Fuller's system of control operates by increasing or decreasing the magnetic field of the generator in order to meet requirements. It can be applied to any purpose wherein the electric current can be controlled at the generating source. Some of the many practical uses which suggest themselves at present are: Motive power for railways, tractors, trucks, fire engines, and similar apparatus; motor coaches, busses, taxicabs, and sightseeing cars.

In the construction of any vehicle for any purpose, the control system under discussion embodies a maximum of flexibility and the greatest variety of speeds, according to Mr. Fuller's claims. A trailer, or a train of trailers, may be synchronized to turn and track with the leading truck or tractor. Each trailer can be provided with motors, and in the case of delivery of freight, each may be left at its respective station for unloading while the train continues with the other units. Furthermore, specially designed trucks may be built for hauling extra long lengths of material such as structural steel, telegraph poles, masts, and so on; and the length of the carrying body may be readily adapted to the requirements, if the rear wheels are driven by motors which are controlled through wires. In fact, in any vehicle the Fuller system of control has the great advantage of doing away with change speed gears or differential gears, which wear and tear and contribute materially toward the early deterioration of the ordinary truck.

The complete wiring diagram below tells better than words how the Fuller system can be applied to a motor truck and trailer.




Wiring diagram of an electrical system of control for motor trucks and other self-propelled vehicles

## What to Know About Radio Activity

DOUBTLESS every intelligent person has now a reasonably good general idea of what radio-activity signifies. He understands that aside from the first radioactive substance discovered, radium, there are a number of others, and that there is a certain relation between them all. He knows that several types of radiation or emanation are given off; he is aware of the fact that there is some sort of progressive degeneration from one form of radioactive matter to another. If he is better read on the subject than the average layman, he understands that the helium atom is suspected of a certain degree of complicity in all this business of breaking down; and he appreciates that the whole subject is intimately tied up with the very nature of matter, even with its genesis. He may or may not have heard the "half-period" mentioned—if he has, perhaps he still looks upon it as a fanciful conception of the novelist who with truly remarkable foresight or even more remarkable luck hit upon this means of representing the rate of decay, and formulated the notions regarding the nature of the decay process which make such a means of timing it in order.

In any event, whatever the extent of the lay reader's familiarity with this field, he knows that it is the one thing of paramount importance in the chemical and physical science of the day. He would doubtless be eager to learn more about it, and get just as clear a notion of what it all invovles, if he knew where to look for that notion. Accordingly, we have sought to meet this need—which we hope and believe is a real one—by commencing, in this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2256 for March 29th, an admirably executed popular address upon *Radium and Radio-Activity*, by Charles H. Viol. Mr. Viol is director of the radium research laboratory of one of our most enthusiastic corporations in the matter of industrial research, and is indeed an authority upon the subject. His address will run through three issues of the SUPPLEMENT; it will be found comparatively easy reading, and sets its subject out in a most illuminating and interesting manner.

## Oil Fields in Alsace-Lorraine

ALSACE-LORRAINE is not only rich in iron ore, coal and potash, but also possesses oil fields of great importance. These extensive oil fields are to afford a considerable resource for France. At a recent date, the Commissioner General of the Oil Committee, Senator Henry Bérenger, accompanied by the members of the Interallied Conference, who were active in affording him all possible coöperation with a view of determining the distribution of supplies to the Allies and the civil population, made an inspection trip to the oil fields and the extensive plants already erected and which the Germans had been operating. The center of the industry is at Pechelbronn, to the northeast of Strasbourg. Although the oil fields were known as far back as the 15th century, industrial working did not commence until the 17th century. Speaking of recent dates, in 1889 the annual production was still small, being only 6,000 tons of crude oil, but in 1900 under a Prussian company the production rose to 30,000 tons. During the war a very active exploitation caused the amount to reach 50,000 tons. The products obtained from the Alsatian crude oil consist especially of fatty oils such as are useful as lubricating oils, or 65 per cent of the total, while the amount of kerosene and gasoline is smaller than for many other crude oils. It is considered that the 40,000 tons of lubricating oil supplied by the Pechelbronn fields represents no less than 50 per cent of the total French consumption. As regards gasoline, only 2 per cent of the national consumption can be thus supplied, and for kerosene, still less. The Oil Committee is now engaged upon active measures for operating the oil fields.


**General View of the Chlorine Plant at Edgewood**

1. Salt preparation building. 2. Substation. 3. Cell house No. 1. 4. Cell house No. 2. 5. Chlorine drying towers 6. Chlorine gas-pipe line to chemical plant. 7. Boiler and evaporator house. 8. Caustic fusion. 9. Drum-making shop.

# United States Chemical Warfare Service—I

## Building a Poison-Gas Plant With a Capacity of 200 Tons Per Day

THE introduction of poison gas by the Germans was a military as well as a moral blunder—a moral blunder because its use was expressly forbidden by the Hague Convention; a military blunder because when the Germans decided to introduce this form of attack, they made the mistake of not waiting to accumulate sufficient gas to make a general attack along the whole line. It was well for the Allied cause that they did not so wait. A similar military blunder, due to impatience, was committed when they introduced the submarine attack upon merchantmen. The intention of waging such warfare long antedated its introduction. Had the Germans neglected all other construction and concentrated on submarines until they had a fleet, say of four or five hundred, and then launched their attack, the result would have been fatal to the Allied cause.

However, terrible although the first attack with gas proved to be, it was limited in area; the Allies came back with the gas-mask, and the Germans' chance of a decision slipped by. The Allies in self-defense made use of gas themselves and ultimately surpassed Germany in this style of warfare. More than that, with the entry of the United States into the war, we developed our gas-making facilities at such a rapid rate that, at the close of the war, we were making over one hundred tons of poison gas per day, and if it had not been for the armistice, we would could have sent by Jan. 1st, to the western front over 200 tons of gas per day, to be sprayed in shells over the whole German front. What this would have meant will be understood when it is stated that the total output of the German factories was only 30 tons of gas per day. Furthermore, we have learned since the armistice that the greatest amount of that most deadly product, mustard gas, that the Germans could manufacture was six to eight tons per day; whereas, on November 11th, we had a capacity of 28 tons of mustard gas and by January 1st would have been in a position to ship overseas 100 tons of mustard gas daily.

### When We Entered the War

At the time of our entrance into the war, we had very little knowledge as to what materials were employed by the enemy and how the stuff was made. But in November, 1917, the Government decided to build a small shell-filling plant on Gunpowder Neck, Maryland, which formed a portion of the Aberdeen Proving Ground reservation, and it was at first intended to have the gas produced by chemical manufacturers and shipped to Gunpowder Neck for loading into the shells. In December, 1917, the Government had decided that a better plan would be to build its own chemical plant and manufacture the toxic materials itself. At that time the property taken over at the Gunpowder Reservation was largely cultivated farm land and there was no provision for housing men or for bringing materials to the site.

**A frozen cube of mustard gas**

Bunk houses were at once built and railway spurs were laid from the Pennsylvania Railroad. Construction was started in spite of the extremely severe winter of 1917-1918. A water supply of 24,000 gallons per minute for manufacturing was brought in from the Bush River. The shipping facilities via the Pennsylvania Railroad were supplemented by dredging a channel from the reservation to Chesapeake Bay to admit of shipment by water.

### The Government Erects Its Own Plant

Because of the urgency of the demand, it was decided to call at once upon the chemical manufacturers of the country to assist both in investigation of processes and in the production of gas. The manufacture of chlorpicrin was begun by a firm at Stamford, Conn., and of phosgene by a firm at Niagara Falls. It was during the winter, as a result of the growing importance of gas warfare and of the representations of French and British officers who came to the United States, that the Government determined to erect a very large chlorine plant of its own, and in January, 1918, Col. Walker, who has been so long and favorably known to our readers as Prof. Walker of the Massachusetts Institute of Technology, was made commanding officer of the Gunpowder Reservation, which is now known as Edgewood Arsenal. In July, 1918, Edgewood Arsenal was made a part of the Chemical Warfare Service under the direction of Maj. Gen. William L. Sibert.

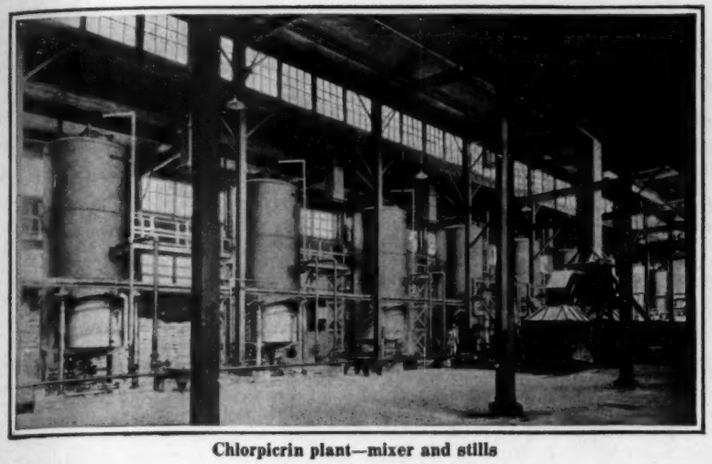
The Edgewood Arsenal comprises the following seven departments:

First, an executive office, which was moved from Washington to Baltimore and was located in McCoy Hall, one of the old Johns Hopkins University buildings; second, the construction, maintenance, and stores division; third, the headquarters military organization; fourth, a military medical hospital; and then the great gas manufacturing plant proper, including, fifth, a chlorine plant for the manufacture of caustic soda and liquid chlorine; sixth, a chemical plant for the manufacture of toxic materials; and seventh, a plant for filling the shells, Livens projector drums, Stokes mortar bombs, hand grenades, etc.

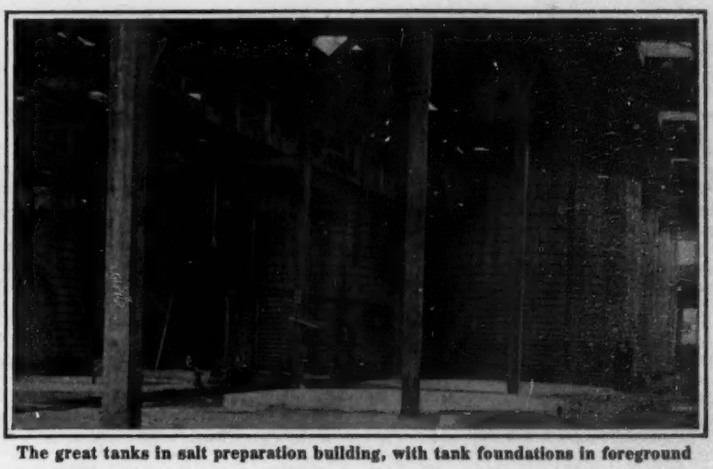
Apart from the construction of the plant itself, a large amount of important engineering work and other constructional work had to be done in housing and taking care of the civilian labor which was employed in putting up the buildings, etc., and in housing the operators, who numbered 6,500, and who were all enlisted men. The operators formed a military organization and regular barracks were built for them, and they were subjected to the same drill and discipline as are found in an army camp. Because of the very real dangers which are ever present in a poison-gas establishment, it was necessary to build a hospital containing 250 beds. Provision was also made for recreation, and each cantonment contained excellent Y. M. C. A. and K. of C buildings, to say nothing of a baseball diamond, athletic fields and similar accommodations conducive to health and recreation.

**Exterior view of cell building. Two of these 82 ft. wide; 540 ft. long**

**Interior of a cell building. Capable of producing 50 tons of chlorine per day**



Chlorpicrin plant—mixer and stills



The great tanks in salt preparation building, with tank foundations in foreground

### Rapid Construction of the Plant

There was a hurry call for the construction of the gas plant, and the response made both by the engineering and chemical experts, who came out of civil life to assist the Government in this emergency, and by the contractors and labor forces, forms one of the most creditable chapters in the history of our war achievements on this side of the Atlantic. Although ground was broken in the winter of 1917-1918, it was not until January, 1918 that Col. Walker was given a free hand, and it was due to his initiative and that of Lieut. Col. E. B. Ellicott, who had charge of construction, that the plant was built in such record time. The magnitude of the undertaking is seen from the following summary of some of the larger buildings:

Two cell buildings, 82ft. by 540 ft., a salt-treating building, 175 ft. by 233 ft., evaporator and boiler house, 203 ft. by 229 ft.

A drum-making building, 82 ft. by 200 ft.

A caustic fusion building, 98¼ ft. by 348 ft.

Twelve magazine buildings, 100 ft. by 200 ft.

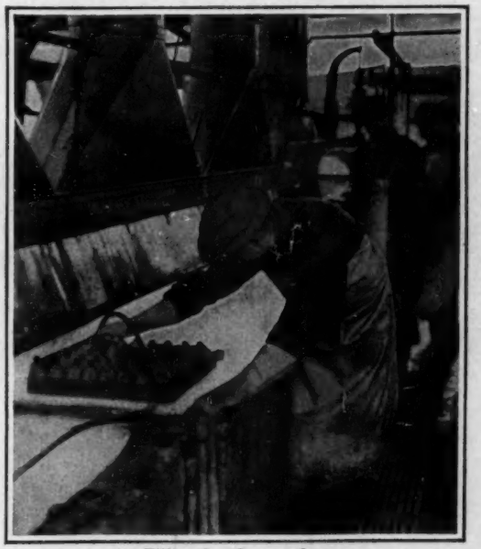
A chlorine pipe trestle, 2,494 ft. long, carrying three 8-inch pipes for the transfer of the chlorine from the chlorine plant to the chemical plant.

Permanent barracks buildings, comprising 16 two-story tile-wall structures, each 50 ft. by 200 ft., electrically lighted and with every accommodation, capable of housing 2,650 men.

A water-supply system, including a 1,300-foot dam, 6 feet high, an electric pumping system, two pipe lines, 10-inch and 12-inch, extending for 6,200 feet to a reservoir at an elevation of 155 feet, of a capacity of 1,600,000 gallons; two pipes, 10-inch and 14-inch, extending from the reservoir 6,000 feet to the reservation, where it is distributed to 11 miles of mains, 16 inches and 14 inches in diameter.

As showing the rapidity of the work, we may take the case of the construction of the chlorine plant, which consists of two large buildings, each 82 ft. by 540 ft. and 24 ft. high. Detailed plans were received on April 26th. Work was started on the cell building on May 1st, and the first of the four sections was ready to receive cells on May 27th, and the last section on June 11th.

Again, excavation for the salt-treating building was started on May 17th and on June 1st foundations were ready for six of the tanks, and all were completed before the 20 tanks that had been provided for arrived. After the tanks were up, overhead railroad tracks were built above them and with these preparations everything was in place ready for the first carload of salt on July 14th.



Filling hand grenades

The chlorine gas is used at a chemical plant located some distance away, with a tide-water swamp intervening. The gas is piped, and to maintain the pipes at the proper elevation, a wood trestle, nearly half a mile long, was built between the chlorine plant and the chemical plant. Work on the trestle was started May 30th and the first pipe line was completed on July 4th.

Current for the plant was secured by tapping a source of supply 10 miles distant and bringing it in on overhead cables to an outdoor sub-station, containing a bank of three, 3333 kw. transformers. This station was ready for service on July 1st, and while the above described work was in progress, enlisted men were assembling the chlorine cells and on July 4th enough cells had been completed to produce two and one-half tons of chlorine gas per day and deliver it to the chemical plant.

### Fifty Tons of Chlorine per Day

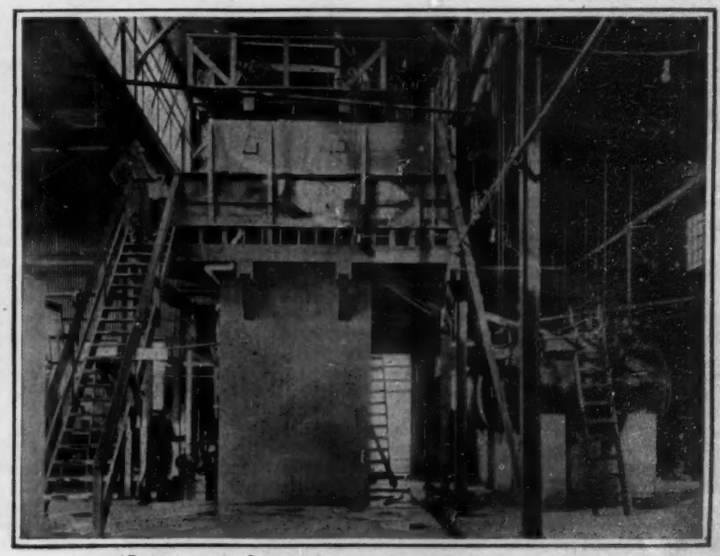
The developments at the chemical plant did not permit the use of the gas at this time and, hence, the plant did not go into operation until the first day of September, when the two and one-half ton unit was first used. But before the armistice was signed, the plant was ready to produce 50 tons of chlorine gas every 24 hours, although the greatest daily requirement at this time was 26 tons.

The plant has been designed with the view of increasing the capacity to 100 tons of chlorine gas per day, and early in the construction period, the order was received to build cell building No. 2, rotary converter building No. 2, and to purchase and instal equipment duplicating that in the first unit. This additional work was proceeded with, and the buildings had been completed and a large part of the machinery was delivered and installed by November 11th. Had it not been for the stopping of work on November 12th, the second unit would have been placed in operation on January 1st of this year.

Another remarkable piece of rapid construction was the building of an auxiliary 20,000 kw. power plant at

(Continued on page 326)

View at the top of a mustard gas unit, showing gages and piping



Latest mustard gas unit; capacity twelve tons per day

# The Heavens in April, 1919

## More Investigations of Star Brightness and Distances

By Professor Henry Norris Russell, Ph.D.

ONE of the most interesting papers of the past month comes from Sweden where, at the University of Lund, a group of very efficient students has been gathered under the distinguished direction of Dr. Charlier. The present discussion, by Gyllenberg, deals with a remarkable and little understood class of bodies—the variable stars of long period.

Stars of this sort have been known for a long time—the first discovery, that of the famous Mira Ceti, dating back to the year 1596. In recent years the number of discoveries has grown apace. At present about 750 stars are known to vary in this fashion, and Gyllenberg concludes, from his discussion that probably at least as many more remain to be discovered.

There are few more definite classes of celestial objects. The periods of variation are always long, averaging about 300 days, and are grouped pretty closely about this mean value—three-quarters of them lying between 200 and 400 days. The range of variation is great. Two-thirds of all those which have been followed through the whole cycle of variation alter their brightness by more than three magnitudes—that is, they are more than sixteen times as bright at maximum as at minimum—while one-third of them all change by more than five magnitudes—that is, by more than a hundred-fold in light—and a few are more than a thousand times brighter at their best than at their poorest.

Spectroscopically these stars fall into a very well-marked group. They are all decidedly red, with spectra showing broad bands, due to the presence in their atmospheres of the vapors of certain chemical compounds—usually the oxide of titanium whose existence proves that the atmospheres of these stars must be relatively cool; from the stellar standpoint, though from the terrestrial side they are as hot as an electric furnace in full blast. In addition to these bands, and to the ordinary dark lines, their spectra show the lines of hydrogen bright, and often very conspicuous, especially near maximum. This indicates that, in some way, the atmospheres of these stars contain large quantities of hydrogen which is hotter than the rest of the atmosphere—perhaps something like the eruptions of hot calcium vapor around sunspots which are revealed by study of the sun with the spectroheliograph.

But the origin of these spectral peculiarities, and of the still more remarkable variations in brightness, remains obscure. Anything that can help to clear up the situation is very welcome, and Mr. Gyllenberg has made an important contribution by obtaining a good estimate of the average brightness of these stars.

It has been known for some years that the red stars which show the bands of titanium oxide in their spectra—called Class M in the Harvard classification—fall naturally into two groups of very different brightness. One group, the so-called "giants," averages 50 times as bright as the sun, or thereabouts. The other group, the "dwarfs," averages less than one per cent of the sun's brightness. Though there is a good deal of difference between individual "giants" or "dwarfs," as the case may be, the two groups are a long way from overlapping and, as far as we know, they are quite distinct.

### Classifying the Variables of Long Period

To which of them do the long-period variables belong? We cannot give an answer based on direct measures of parallax, for only one such star has thus far been observed for parallax, and with rather inconsistent results. But an answer is possible, based on the apparent proper motions of the stars in the heavens.

If these variables are "dwarfs," they must really be very faint, and, to look as bright as they do, they must be pretty near us—at distances of ten to thirty light-years, for the most part. If they are as near as this, their own motions in space, and the apparent drift arising from the motion of our own system, will carry them across the heavens at a rapid rate, for stars, which could not fail to be detected by observation. If on the other hand they are "giants," they must be at considerable distances, or else they would look brighter than they do, even at maximum; and being thus remote, their apparent motions in the heavens would be slow.

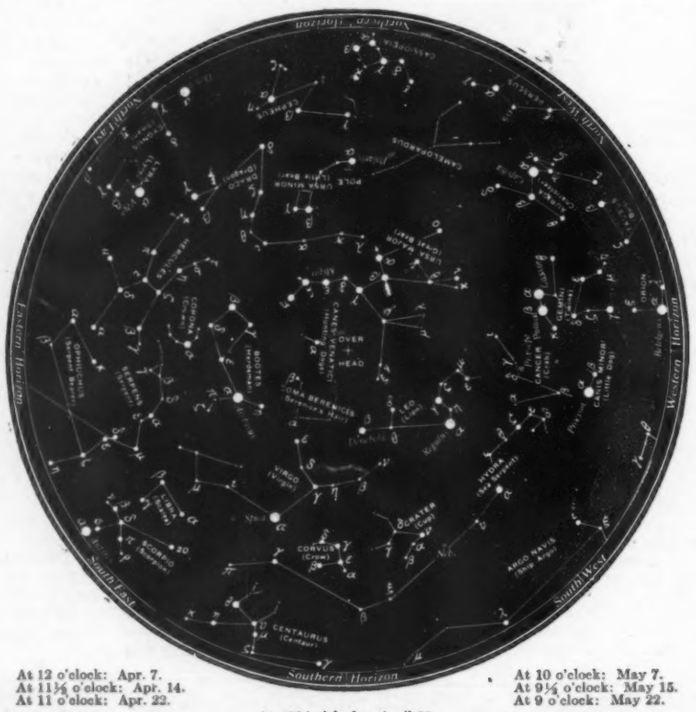
The writer, some years ago, showed that the motions of the few stars of this sort which appear in Boss's catalogue were so small as to make it very probable that these stars were "giants." Mr. Gyllenberg has repeated this discussion, with considerably more extensive data gathered carefully from various reliable sources, and confirms the conclusion. From the average drift due to the sun's motion he finds that the average parallax of 42 such variables is only 0."005 which would correspond to a distance of more than 600 light years. Working on the assumption that all these stars are equally bright when at maximum (which though probably not at all exactly true, affords a good enough basis for a preliminary discussion), he finds that, at maximum the long-period variable is 150 times as bright as the sun, and hence is a good bright "giant" star. At minimum these variables probably sink to the sun's brightness, and possibly below it in a few cases. But it is clear that, speaking by and large, they are objects of great luminosity.

This settles at least one thing about the nature of their variations. They are certainly *not* stars which are at the point of going out, and flaring up at intervals "like a candle flickering in its socket." The faintest dwarf red stars are apparently nearing extinction, according to all the available evidence; but they are not variable, so far as is at present known. Variability of this type is a property of giant stars, which there is good reason to suppose to be in an early stage of their career, and it looks at present as though they were, perhaps to be regarded as bright stars which become faint at intervals, rather than as faint stars which at times flash out bright. We are still far from a solution of the problem, but it is an essential advance to know that we are dealing with very bright stars, which are almost certainly of large diameter and low density as well.

### How Big Is Our Stellar System?

Mr. Gyllenberg completes his discussion by calculating the actual positions in space of 700 of these variable stars, on the assumption that their maximum brightness is in all cases 150 times that of the sun. The results indicate that these stars are scattered through a huge region, extending along the plane of the Milky Way to a distance of at least 4,000 light-years in all directions, while some of them appear to be not less than 6,000 light-years distant. At right angles to the galactic plane they extend on both sides to a maximum distance of 4,000 light-years again; but two-thirds of them lie within 900 light-years of the plane in question.

This distribution is fairly similar to that which was calculated by Shapley and the writer some years ago for the eclipsing variables, though this later calculation makes the limits of the great star-cloud within which our system lies somewhat larger. It is probable that in the direction at right angles to the Milky Way the actual limits of this cloud of stars have been roughly defined; but along the plane of the Galaxy it is not probable that this investigation, any more than others, has "struck bottom," for the study cannot at present be carried to faint enough stars, and the maximum estimated distance o any of the stars studied by Gyllenberg is but one-third of the distance assigned by Shapley to the nearest of the globular clusters.




At 12 o'clock: Apr. 7.
At 11½ o'clock: Apr. 14.
At 11 o'clock: Apr. 22.

At 10 o'clock: May 7.
At 9½ o'clock: May 15.
At 9 o'clock: May 22.

At 10½ o'clock: April 30.

The hours given are in Eastern Summer Time

NIGHT SKY: APRIL AND MAY

### The Heavens

At the time set for observation, which is in April an hour later than usual by virtue of the daylight saving, the Great Dipper is above the Pole, and nearly overhead. Below it and stretching far to the eastward is the long curve of Draco, enclosing the Little Bear in its coils. Below the Pole are Cassiopeia and Cepheus, deep on the horizon. In the northeast Vega has risen, with Hercules higher up on the right, and Corona farther in the same direction, while in the east Arcturus rides high, above the tangled outlines of Serpens and Ophiuchus.

Virgo is well up in the south and Leo in the southwest. Below them is Hydra, with Crater and Corvus on its back. Far to the southward, on the horizon, observers in Florida or southern Texas may, in clear weather, discern the Southern Cross.

The western sky is the brightest of all, with Auriga in the northwest, Gemini on the left, and then Canis Minor. Jupiter, which is in Gemini, and Saturn, in Leo, add to the effect.

### The Planets

Mercury is an evening star at the beginning of April, but passes through conjunction between us and the sun on the 8th, and becomes a morning star. By the end of the month he may be seen in the morning twilight, rising about 5.15 A. M., summer time; but he is not very well placed for observation in this latitude.

Venus is an evening star in Aries and Taurus, and is coming steadily farther north, and growing very conspicuous. At the end of the month she remains in view till nearly 11 P. M. by the clock, and appears about five times as bright as Sirius.

Mars is theoretically an evening star, but is actually much too close to the sun to be visible.

Jupiter is an evening star in Gemini, and remains in sight till about 1.15 A. M. These apparently inconsistent statements may be reconciled by a consideration of the planet's high northern declination and the hour's shift in the clock.

Saturn is in Leo, crossing the meridian at about 9 P. M. in the middle of the month.

Uranus is in Aquarius, and rises about three hours before the sun at the end of the month. Neptune is in Cancer, crosses the meridian at 8 P. M. in the middle of the month.

The moon is in her first quarter at 9 A. M. on the 7th, full at 4 A. M. on the 15th, in her last quarter at 7 A. M. on the 23d, and new at 2 A. M. on the 29th. She is nearest the earth on the 1st, and again on the 30th, and farthest away on the 16th.

During the month the moon is in conjunction with Mars and Mercury on the 1st, Venus on the 2d, Jupiter on the 6th, Neptune on the 8th, Saturn on the 10th, Uranus on the 25th, Mercury again on the 28th, and Mars on the 30th. The conjunction with Venus is close; and will be worth watching.

Princeton University Observatory.
March 17th, 1919.

# World Markets for American Manufactures

Edited by LYNN W. MEEKINS

*A department devoted to the extension of American trade in foreign lands*

## Electrical Progress in China

SOME years ago a famous American bandmaster composed a march that still retains its popularity. The title, "Hands Across the Sea," originally alluded to the Atlantic Ocean, but now the same expression is being used in connection with the Pacific Ocean, and the hands generally indicated are those of the Chinese. Recently the Chinese Industrial and Commercial Association of Chicago was formed, the first organization of its kind in the United States. Its object is to promote commercial relations between China and America. At the opening session the Chinese Consul-General at New York brought out the interesting point that the United States is the only country that has not had a special motive in dealing with China. Other nations have tried to exploit the Chinese—the Americans have tried to help them. As a result, they want to buy five times as much from us in the future as they are purchasing now, and $3,000,000 has been raised by Chinese merchants in San Francisco toward the establishment of a new steamship line between San Francisco and Shanghai.

"American manufacturers have a good opportunity at present to develop the Chinese electrical field," said an American engineer who visited the Far East last year. "There is a strong demand for new central stations and the necessary apparatus and materials. Not more than 100 Chinese cities now have electrical service, but hundreds of others are good prospects. There are several plants in Peking, Shanghai, Hankow and Tientsin, the foreign and native sections being served by different companies. When I went to China, my firm had received very discouraging reports about the industrial backwardness of the country, the low purchasing power of the people and the active competition of Japanese and British manufacturers. The first of these obstacles will be overcome by the investment of American capital and the furnishing of technical assistance. Lack of adequate transportation prevented the distribution of labor throughout the country, and the congestion in the larger centers has kept down the level of wages. As to meeting competition, American electrical equipment has a high reputation for quality and needs only capable introduction to gain a good share of the market. When a central station is installed by American interests, an American-trained Chinese is placed in charge and periodical inspections are made by an American engineer, most of the business resulting from the establishment of that station should come to the United States."

### Our Steadily Advancing Trade

The growth of American trade in electrical goods is shown by the value of the imports into China from this country during the fiscal year 1918, which was about $1,000,000, compared with approximately $125,000 in 1913. Last year the United States supplied dynamos or generators, fans, insulated wire and cables, motors and telephones. Oppressive summer weather makes the electric fan even more of a necessity in many parts of China than it is in the United States. Both portable and ceiling fans are used. Often operated continuously for a whole day or more, they have to contend with severe humidity conditions that cause insulation leaks and breakdowns. It is so damp along the coast from Canton to Shanghai and the north that fans often give annoying shocks. Under trying conditions the American fan has given much more satisfactory service than its foreign competitors, and the ceiling type has a strong hold on the market.

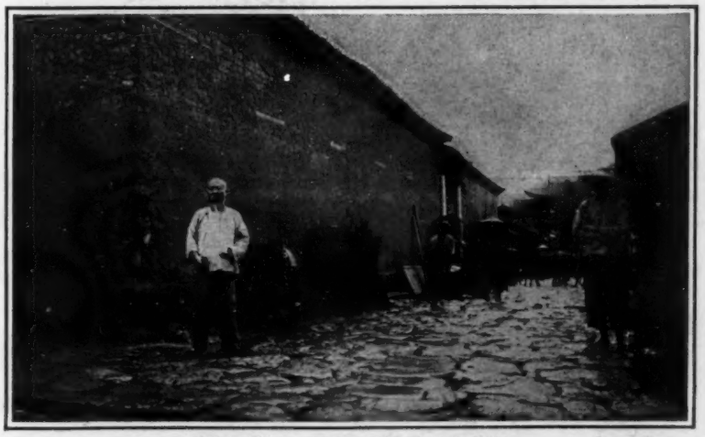
In some Chinese cities fairly elaborate electric signs have been erected, usually consisting of Chinese characters made of sheet metal in the form of a trough in which the lamps are set. The Chinese appreciate sign advertising and realize the advantages of making it effective by the use of electricity. A prominent characteristic of the people is their universal pride in keeping up appearances. When one Chinaman gains an advantage over another, the latter "loses face" and can regain his standing in the community only by getting back at his competitor. So if one retail shop is persuaded to purchase a complete electric lighting system, other shops try to meet the standard. In the opinion of an American familiar with electrical possibilities in China, small lighting sets can be sold extensively if manufacturers will send agents to demonstrate such apparatus.

### Meeting Competition in Telephone Instruments

It is reported by an American Trade Commissioner that notwithstanding the cheap labor of Japan, American telephone manufacturers can turn out instruments as low-priced as those of their Oriental competitors. Nickel plating scales badly in the humid climate of Shanghai and lacquered brass finish is preferable. Not long ago, an American company made the lowest bid in connection with a Chinese Government telephone contract, but instead of giving it the order, the Chinese official in charge gave the American figures to another bidder and placed the contract with him because the official had been properly "squeezed," that is, financially influenced in advance. The American company, however, was looking out for this and finally landed most of the business in spite of the official.

Shanghai is the only city in China where the larger types of electrical cooking and heating appliances have had much sale. When central stations in other cities make reasonable rates, these products will have a considerably increased market. Modern heating systems are generally lacking, although the winters, especially in North China, are rigorous. The houseboy and the cook, who prepare the food for foreign residents, do all they can to encourage the use of coal or wood stoves, because they derive a small commission from buying the fuel. One American family who used an electric range found its servants so wasteful of current that it had to go back to the antiquated but cheaper coal stove.

Japanese traveling commercial exhibition in Manchuria



This Chinese city needs electric lights

### Selling Methods and C. I. F. Prices

The methods of selling American electrical goods in China are through the branch houses of manufacturers, through local importers acting as manufacturers' agents with exclusive sales rights, or by branches of American commission houses. Except in the case of apparatus bought direct by central stations, the importers sell the goods to Chinese dealers who act as jobbers and distributors through outport merchants. These sales are made through compradors, who are more then credit men, because they generally guarantee the accounts of their customers. The disadvantage of the comprador system is that the importer is prevented from learning enough about local conditions to develop his business to the fullest extent. He does not become well acquainted with the ultimate consumer, and he runs the risk of losing money if the comprador sets aside more than a legitimate share of the profits.

The Chinese merchants desire as a rule c. i. f. (cost, insurance, freight) quotations. American exporters have been known to quote prices f. o. b. (free on board) inland town in the United States, and the bids have been refused because the importers lacked information on American railway freight rates and were unable to figure the cost of the goods landed in China. In one case a British manufacturer named a c. i. f. price for certain goods, and an American maker quoted f. o. b. at the factory. The Chinese importer spoke to the American Consul about it, and with the aid of that representative he figured out delivered prices on American goods, which proved to be lower than the British, and swung the order to the United States. Even when ocean rates make it difficult, if not impossible, to reckon the cost, insurance and freight prices, free-on-board at an American port enables the Chinese importer to estimate the total cost of his order. The Chinese want to buy a great deal more from us, and it is only fair to make it easy for them.

The most effective advertising for American electrical goods in China consists of figures and designs featuring the particular "chop" or trade-mark of the American manufacturer. The Japanese have employed, among other methods of publicity, traveling commercial exhibitions in elaborately placarded trains, which attract much attention in the towns and villages through which they pass. As new railway lines are built, and additional territory is opened, it would seem worth while for the branches of American firms in Shanghai, Hankow and other Chinese ports to arrange for American advertising enterprises of this sort. The Chinese buyer invariably wants to see actual samples, and this would be an effective way to place American manufactures before him.

## Extraction of Turpentine in Germany

BEFORE the war Germany imported oil of turpentine from southern France. The fir trees of southern France contain less fats and more turpentine than those of Germany. The latter require a greater proportion of fatty substances to enable them to withstand the rigors of the German winter.

The extraction of oil did not prove remunerative, as the oil-producing qualities of the German fir trees compare unfavorably with those of France, and it is impossible to make the industry a paying one under the conditions.

A very easy method has been successfully tested for the extraction of oil from fir needles, the resulting product possessing good technical qualities and remarkable power of resistance to cold temperature. This process has been substituted for the expensive method of extraction by means of alcohol, which is practically impossible under present conditions. Preparatory steps have been taken for employing the process, and in the future the national economy of Germany will benefit by the extraction of several hundred thousand kilos (a kilo=2.2 pounds) of oil; pure oil of turpentine (turps) will be an added article of competition, which according to experts will compare favorably with the French product.

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

## Animating Stationary Signs by Means of Colored Lights

THERE is nothing new in the principle of the absorption of light rays by complementary colors. Indeed, M. Luckiesh, a recognized authority on color and illumination and a frequent contributor to these columns, demonstrated some years ago the effect on paintings of various colored illumination with the resultant altered appearance of the pictures to a marked degree. But there is distinct novelty to the practical application of this principle to advertising signs, which is covered in a patent recently granted to Richard M. Craig of San Antonio, Texas.

According to the specifications of his patent, Mr. Craig paints the subject matter of his sign in two positions, one position being shown in red and the other in green. Then he arranges both red and green lights for illuminating the sign, and alternately switches the current from one group of lamps to the other by means of a motor-driven switch. In the accompanying illustration, for example, is depicted an animated sign consisting of a rocking chair and a see-saw. These articles are each painted in two colors—in red for the first extreme position and in green for the second extreme position. In broad daylight, the two positions in red and green show plainly; but when illuminated alternately with red and green lights, the sign becomes animated in a most startling and convincing manner.

## A Phonograph Without Tone-Arm, Sound-Box, and Horn

SOMETHING radically new has at last been introduced in phonograph instruments. Indeed, the more or less complete standardization which has long obtained in reproducing phonographic sounds is now threatened by a recent development which is as ingenious and startling as it appears efficient.

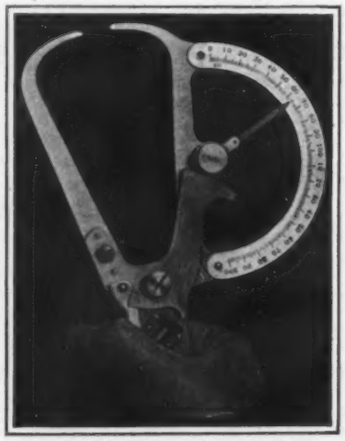
In brief, the development in question is the elimination of the usual tone-arm, sound-box, and horn. Instead, the new system of reproducing phonographic sounds makes use of a cone-shaped parchment diaphragm held in an aluminum ring which, in turn, is suitably suspended by a trunnion and swivel mounting so as to bring the long stylus arm to bear on any portion of a disk record. The free end of the stylus arm terminates in the conventional needle holder, which takes steel or fiber needles, as well as the various jewel and semi-permanent styluses. By giving the aluminum ring a slight turn, the diaphragm is ready to play either hill-and-dale cut or lateral cut records.

It will be noted that the vibrations from the record groove are transmitted by a long brass lever which passes through the heavy brass arm. This brass lever terminates at the apex of the cone; and it is said that this arrangement of imparting the vibrations to the parchment diaphragm causes more or less of the resonant surface to vibrate, according to the harmonic requirements of the vibrations. The cone amplifies the sound to such a degree that a horn is unnecessary; in fact, it is the elimination of the horn with its inevitable characteristic tone which generally alters the purity of the sounds emitted by the phonograph diaphragm, and which causes a muffled effect.

In actual operation the new phonograph gives pleasing results. On band and orchestra records it gives a fullness and depth of tone that is seldom if ever approached in other phonographs, because of the low natural tone of the parchment cone. On vocal selections too, it works out well.

## A Caliper That Carries Its Own Scale

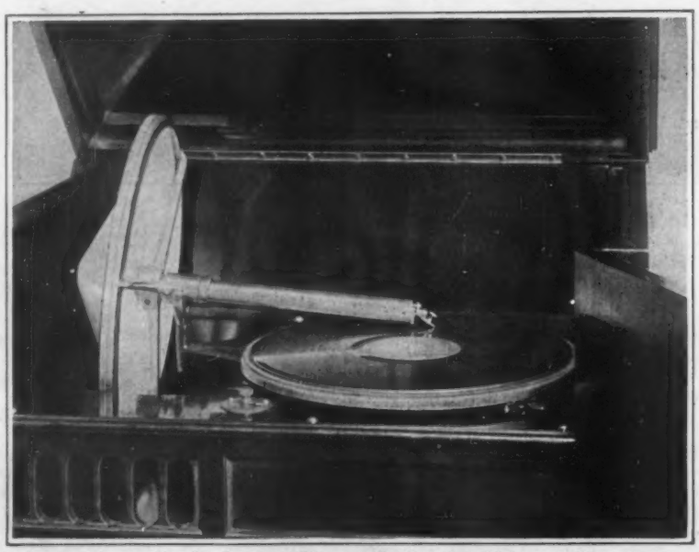
THE time honored methods of calipering a piece of work is to transfer the measurement with the ordinary calipers to a steel rule or to adjust the calipers from a steel rule. To do this accurately requires considerable skill. The tool here illustrated simplifies the process by combining the rule with the calipers, and the graduations on the rule are enlarged to double or triple scale, so that measurements can be made with accuracy. As clearly shown in the picture, one of the caliper arms is formed with a toothed sector which engages a pinion on the other arm. This pinion carries an indicating hand which sweeps over an indicating scale. In the model here shown the graduations represent hundredths of an inch, although they are actually three times as far apart as that, so that it is possible to measure accurately to a three-hundredth part of an inch. In a larger model the graduations represent sixty-fourths of an inch and are double scale, so that they can easily be read to half a sixty-fourth.



An indicating caliper, a useful tool, which insures accurate measurements

The arms of the caliper are adjusted by means of a trigger placed conveniently near the handle, and there is an adjusting screw on the handle operated by a thumb nut, which may be brought into engagement with a spur on one of the arms to lock the instrument at the desired measurement or regulate the opening of the arms to a nicety. Provision is made to compensate for any wear in the gear teeth so that the caliper remains always an instrument of precision.


By painting signs in red and green and using alternately a red and a green light, a startling animation may be secured



A recent innovation in phonographic reproduction, in which a parchment cone acts as the sound-box and horn combined

## Recent Patent Decisions

**With Reference to Novelty.**—Patent for a cable hanger by which to attach lead tube carrying electric wires to a supporting steel cable, called a messenger, held valid. This consists of the loop and hooks, a pair of spacing arms extending outwardly in opposite directions from the neck of loop, passing obliquely underneath and along the sides of the messenger wire and ending in ordinary overhanging hooks. On first view it seems like the primitive hanger with hooks set above the loop, but on closer inspection it is apparent that the hooks are farther apart, and that they grip in a way the hooks of the early hanger did not. —*Bonita Mfg. Co. v. Blackburn, U. S. C. C. A. of Pa.*

**Design Patent vs. Mechanical Patent.**—The Pick patent for an improvement in drinking glasses consisting of a shallow bulge below the rim, held valid. The bulge is not ornamental and hence the issuance of the design patent could not invalidate a prior mechanical patent for such glass, on the ground of double patenting.—*Ferd. Messner Mfg. Co. v. Albert Pick & Co. U. S. C. C. A. of Mo.*

**Option to Take License.**—Provision of contract giving one the privilege of becoming, at a certain time, exclusive licensee to manufacture under a patent, provided he give 10 days notice of his intention, and within such period furnish a bond, gives but a mere option, as to the exercise of which time is of the essence.—*Life Preserver Suit Co. v. Natl. Life Preserver Co. U. S. C. C. A. of N. Y.*

**No Jurisdiction.**—Equity is without jurisdiction of a suit for infringement, where defendant had used only one of the alleged infringing machines, had ceased its use and disposed of it months before suit, and did not threaten further use.—*Munger Ldy. Co. v. Natl. Marking Mach. Co. U. S. C. A. of Iowa.*

**What Is Disclosure?**—In a suit to enjoin infringement of patent, where plaintiff claimed that the present commercial form of his invention was not a departure from the original disclosure, plaintiff had the burden of proving that any journeyman of the art could turn from present form to former with any certainty of result. An inventor muts do more than give cues for future experiments, and, unless he is dealing with elements whose action and reaction is known and certain, he must disclose how the combination will operate.—*H. Ward Leonard, Inc. v. Maxwell Motor Sales Corp. U. S. C. C. A. of N. Y.*

**Basis for a Patent.**—The only basis for granting any patent is the specifica-

(Continued on page 327)

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

### Pertaining to Aeronautics

ACTUATOR FOR AEROPLANE STABILIZERS.—A. B. THAW, 640 Park Ave., New York, N. Y. Among the principal objects which the invention has in view are, to provide a stability element operatively suspended by head wind pressure to provide a stabilizer having a cooperative balanced weight member and an air pressure member, said members being disposed in balanced relation, and to provide an actuating weighted member disposed responsive to movements of a carrying member in a vertical plane.

DIRIGIBLE AIRSHIP.—C. D. FAHSEL, Decd. address, Mrs. Nellie Fahsel, 611 W. 177th St., New York, N. Y. Among the objects of the invention is to provide an airship which will embody in its construction a parachute effect whereby it will be impossible for a serious disaster to result because of the failure of any of the mechanism on the bursting of any or all of the gas bags, and to provide means for steering and stabilizing.

ALIGHTING AND LAUNCHING STAGE FOR AIRPLANES.—I. G. BURTON, 1482 Broadway, New York, N. Y. The object of the invention is to provide an alighting and launching stage for use on aviation fields, house tops, decks of marine vessels and the like, arranged to insure a safe alighting of an airplane and to check the momentum thereof in a comparatively short space, and to allow of properly launching the airplane into the air. Another object is to provide a durable construction not liable to get out of order.

### Pertaining to Apparel

NECKTIE.—W. NAZUM, 98 Park Place, Brooklyn, N. Y. This invention has for an object the provision of a construction whereby the tie may be removed from collar easily without untying the knot. A further object is to provide a retaining bar for the small end of the tie, and a bar or strip formed with means adapted to be secured to the shirt of the wearer so as to hold the tie near the shirt without requiring the use of a tie clip.

BUTTON FASTENER.—C. J. DAHLGREN, 212 Broadway, New York, N. Y. The object of the invention is to provide a button fastener arranged to permit the wearer of a garment, hat or other wearing apparel, to quickly and securely fasten a button to the wearing apparel. Another object is to permit the use of the fastener on various types of buttons such as cloth buttons, apertured buttons, eye buttons and the like.

### Electrical Devices

THERMOSTATIC CIRCUIT CLOSER.—M. F. ARIAS, 105 Fulton St., Brooklyn, N. Y. The invention relates to thermostatic circuit closers suitable for closing electric circuits, operating valves or any other purpose where action under thermal changes is desired. A specific object is the provision of a thermostat in which one of the elements is a tube and the other a plurality of untwisted strands of wire, the tension of which can be readily adjusted according to the delicacy required.

### Of General Interest

BOTTLE CAP.—A. L. BERNARDIN, Evansville, Ind. The prime object of the invention is the provision of a cap construction which will avoid the necessity of screwing the cap upon the bottle and which will thus avoid a great waste of time in opening and closing the bottle during the gradual using of the contents, and also avoid the initial manual screwing of the cap prior to the application of power thereto for compressing the sealing member in the first instance.

PERCOLATOR.—P. MALCAMP, cor Derbigny and Frenchman Sts., New Orleans, La. The invention has for its object to provide a percolator adapted for use with a heater, wherein the arrangement is such that the percolator may be arranged to retain the burner with a blue flame during the making of the coffee and to permit the heater to burn with a white flame after the coffee has been made, or wherein the percolator may be arranged to extinguish the heater when the coffee is made.

ICE BOX AND WATER COOLER.—J. T. PETENS, Crossett, Ark. The invention relates particularly to an ice box having a water cooler structure forming a part thereof, and having for an object the provision of an arrangement whereby ice will act in a double capacity of cooling drinking water and the contents of the refrigerator in substantially the usual manner. The container for drinking water is supplied with an inlet and an outlet member. The ice chamber is constructed to prevent the ice coming in direct contact with the water.

NAVIGATION INSTRUMENT.—C. L. POOR, 35 Thomas St., New York, N. Y. The object of the invention is to provide an instrument for aerial and marine navigation, especially designed for directing a vessel on a spiral course known as a "search curve," or any portion of such course, or upon an irregular, broken course composed of sections of the spiral course.

GUN MOUNT.—P. L. E. DEL FUNGO-GIERA, care of Maxims Munitions Corp., 120 Broadway, New York, N. Y. This invention relates to gun mounts, utilizing a ball and a socket joint whereby the gun may be adjusted or swung in any direction desired and whereby the gun may be held in either a horizontal plane in any adjustment, or in a vertical plane in any adjustment.

LIFE BELT.—P. BERGEN, care of Monticello Public Schools, Monticello, Wis. This invention relates to a life-saving appliance including an inflatable life belt and a gas generator adapted to be held on the body of the wearer of the belt; the generator being adapted to contain a substance which in the presence of water will generate a gas for inflating the belt.

BULL RING.—C. D. BRODERICK, R. F. D. No. 1, Chazy, N. Y. This invention relates to animal nose rings, such as anti-sucking or bull rings, its object is to produce a durable device capable of easy application and one which will

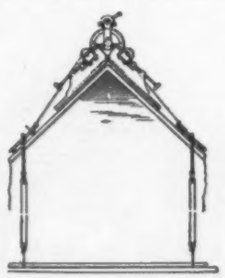
A PLAN VIEW OF THE DEVICE

not interfere with the animal while eating or drinking. The lower loop can be used as a leading ring and when used as such the device cannot be pulled out of the animal's nose as any strain at the end of the lower loop tends to tighten the grip.

### Hardware and Tools

SAFETY HOOK.—T. N. ROBINSON, 37 Stevens St., Astoria, L. I., N. Y. This invention relates to hooks used in hoisting or handling articles of considerable weight. An object is to provide a hook with a pivotally mounted safety catch arranged to extend from near the shank to near the point so as to accommodate the usual size cable or other article while locking the cable against removal.

ROOF JACK.—S. DECKER, R. F. D., No. 2, Lovejoy, Pa. The invention has for its object to provide a jack especially adapted for swinging scaffolds, to be arranged upon the comb of the roof to support a swinging scaffold at the end of a



A FRONT VIEW SHOWING JACK AND SWINGING SCAFFOLD

building, the jack is so arranged that it may be adjusted to a roof of any pitch, and wherein carriages are provided for engagements by the support of the scaffold, the carriages being adjustable toward and from the jack.

MICROMETER CALIPERS.—J. A. DAVIDSON, 307 Congress Ave., Indianapolis, Ind. The object of this invention is the provision of effective means in connection with adjustable pressure controls whereby to obviate further movement of the registering thimble when a predetermined pressure on the article being measured has been reached. The invention provides a handle for rotating the thimble together with means whereby when the spindle engages the work, the registering thimble can no longer be rotated.

CASTING APPARATUS.—T. BROADBENT, 553 Chrisler Ave., Schenectady, N. Y. This invention has for its object to provide a casting apparatus especially designed for casting a plurality of rings or other articles at one operation

A CROSS SECTION OF THE CASTING APPARATUS

in a single flask. Another object is to permit casting of rings of different diameters at one operation. A further object is to produce cast articles which are exceedingly clean and homogeneous, and to dispense with the employment of a skilled molder.

### Machines and Mechanical Devices

CLOTH ROLLER.—W. A. ROTHHOLZ, address Ed. Endelman, 299 Broadway, New York, N. Y. The invention while capable of wider use is more particularly intended for embodiment in the cloth rollers of sponging machines or like rollers on which the cloth is temporarily wound and from which the coth must be drawn endwise of the roller. The prime object is to provide a roller that may be withdrawn from the cloth roll without any damage to the cloth, which frequently happens at the interior of the roll when ordinary rollers are used.

SAW FITTING DEVICE.—G. ANDERSON, 401 Fifth Ave., Seattle, Wash. Among the objects of the invention is to provide means for a series of predetermined, unvarying, and rapidly interchangeable adjustments of the raker teeth filing gage, for producing desirable lengths of raker teeth of different saws, and to provide the frame of the device with an integral filing gage surface in combination with vertically adjustable antifriction cap plates for increasing efficiency and rigidity.

### Musical Instruments

DIAPHRAGM FOR TALKING MACHINES.—F. V. VAN DE MYER, 256 W. 78th St., New York, N. Y. Among the principal objects which the invention has in view are, to adapt a diaphragm for vibrating in sympathy with a variety of tones, to avoid mechanical or foreign overtone in reproducing sound vibrations, to provide a reproducer sympathetic with the human voice, and a vibrator unaffected by climate.

### Prime Movers and Their Accessories

PRIMING CUP FOR INTERNAL COMBUSTION ENGINES.—L. W. MCCAUGHREY, 354 W. 58th St., New York, N. Y. Among the objects of this invention are, to provide a proper charge of volatile liquid content for forming an explosive compound when priming an internal combustion engine, to provide for varying the charge, to automatically repeat the charges, to provide an auxiliary reserve supply of liquid, and to provide means for relieving the compression of cylinders without multiplying the structural elements used in building the engine.

### Railways and Their Accessories

AIR HEATER FOR LOCOMOTIVES.—C. ROCHELLE, 717 W. Morgan St., Raleigh, N. C. The invention relates to air heaters for locomotives its object is to provide mechanism for heating the air and delivering it to the fire box of the engine, so arranged that direct draft may be avoided, and wherein means is provided for admiting cold air to the fire box when desired.

MINE CAR WHEEL AND AXLE.—T. A. PARKER, care of Crawford & McCremmon Co., Brazil, Ind. An object of the invention is to provide a mine car wheel and axle assembly comprising a simple wheel consisting of few parts which may be readily secured in position upon the axle in such manner as to retain a roller bearing assembly in position within a roller bearing chamber and to provide a smooth bearing surface both at the front and rear faces of the hub.

### Pertaining to Recreation

TOY CANNON.—J. B. BLACKSHEAR, 113 Hotel St., Honolulu, Territory of Hawaii. The invention, although adapted for different projectiles, is more particularly intended for the firing of a sectional projectile. An object is to provide a cannon improved with respect to the breach and the elements associated therewith to insure the proper insertion of the projectile with facility, and also with respect to the firing means, trigger, and controling means.

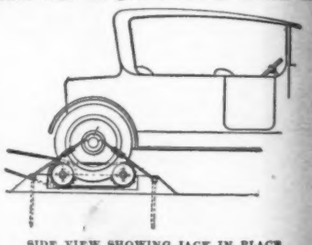
TOY AUTOMOBILE AND RAPID FIRE GUN.—J. B. BLACKSHEAR, 113 Hotel St., Honolulu, Territory of Hawaii. This invention relates to a toy which simulates an armoted automobile and which is equipped with a rapid fire gun automatically fed and discharged in unison with the propulsion of the automobile. An object is to provide for automatic feeding of the projectiles with the minimum liability of the feed means becoming choked, and to insure the discharge of the projectiles in single session.

FOLDING HAND SLED.—C. B. THORESEN, 666 47th St., Brooklyn, N. Y. The object of the invention is to provide a hand sled arranged to permit of conveniently extending the sled for use or folding it to form a comparatively small, flat bundle, which can be readily carried about or shipped, or stored without taking up much room. The sled is provided with a seat, a back rest and spreading and locking device for the runners.

### Pertaining to Vehicles

WIRE SPOKE WHEEL.—G. P. B. HOYT, 1 Clinton Place, Jamaica, L. I., N. Y. The object of the invention is to provide a wire spoke wheel for use on automobiles, bicycles and other vehicles, arranged to render the wheel exceedingly strong, to permit of conveniently and quickly placing any one of the spokes in position on the hub and rim of the wheel, and to dispense entirely with nipples, nuts and like devices.

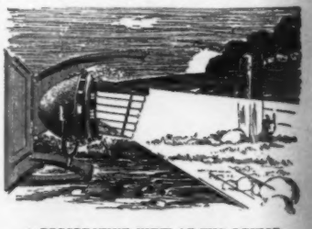
JACK.—J. TRAUX, Sycamore, Ohio. The invention relates to jacks for supporting the rear wheels of an automobile or motor truck out of contact with the ground and in contact with



SIDE VIEW SHOWING JACK IN PLACE

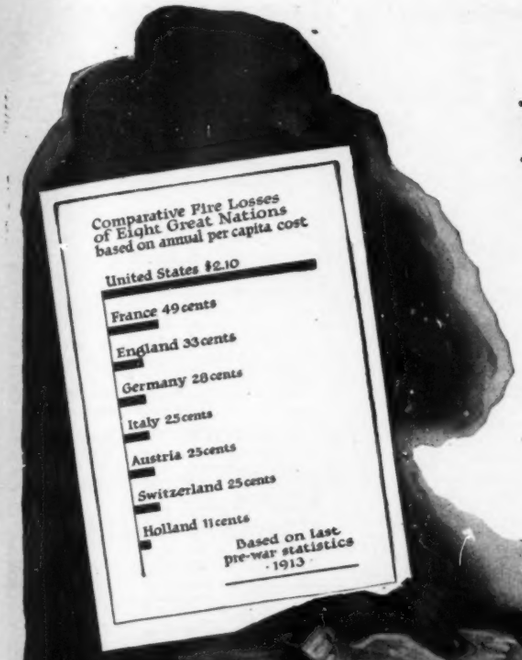
rotatable members which may be driven by the rear wheels of the vehicle to enable the power of the motor to be used in other work than in driving the vehicle.

HEADLIGHT GLARE SHIELD.—D. G. KNECHT, 35 N. 9th St., Allentown, Pa. The invention relates to the headlights of automobiles or other similar vehicles. The object is to pro-



A PERSPECTIVE VIEW OF THE DEVICE

vide a device in which the light is directed downwardly so as to illumine the road, without however being diminished in intensity. A further object is to provide a device in which means is provided for preventing the glare which is dangerous to persons approaching the machine.




# Fires cost more than fire prevention

IN America, of all the countries, fire's course is the most destructive. The tax it lays upon each one of us is four times greater than that in European lands (see chart at left). In this there can be no indictment of our own fire-fighters, the admiration of the world. The indictment lies rather upon our ways of building. It lies upon our inflammable roofs, through which fires spread—just as the way to community and personal fire-safety lies unquestionably in Asbestos Roofing, that repels fire, limits it, confines its destructive powers.

Among thoughtful people everywhere Asbestos Roofing is accepted as Nature's best defender against city-wide fire-threat—made great or small, according as each among us gives this fire protection to his own property. Asbestos Roofing is the true Sentinel of Safety to communities, wherever it is used.

* * * *

"Asbestos" and "Johns-Manville" are words that are almost synonymous today. Just as Asbestos is Nature's greatest protector against fire, so Johns-Manville is the greatest authority upon Asbestos Roofing. There is a Johns-Manville Asbestos Roofing for every building structure—regardless of its size or character.

Johns-Manville Asbestos Roofing satisfies every possible roofing requirement. Its use grows greatly. And in the proportion of its growth America's line upon the fire-chart above will be reduced.

**Johns-Manville Asbestos Roofings:**
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**FIRE PREVENTION PRODUCTS**

# JOHNS-MANVILLE
## Serves in Conservation

## The Current Supplement

THERE are a great many industrial operations which call for a deal of scientific knowledge in their successful prosecution; but ordinarily this knowledge may be confined to a single field. Every little while, however, we meet an industrial technique which lies so in the borderland between two, or even more, sciences, that it cannot be undertaken without good knowledge of them all. Such a process is *Disinfection by Heat*, in which chemistry, physics and bacteriology all play an important role. The way in which this comes about is interestingly discussed in an article bearing the above title in the SCIENTIFIC SUPPLEMENT for the current week, Number 2256, for March 29th. A British observer writes entertainingly upon *Social Wasps and Their Ways*, bringing out facts about these insects which will doubtless be new to many readers. The automobilist will read with profit the article *Spark Gaps*, which makes many valuable suggestions regarding the construction and use of these useful little members. *The Colloidal Membrane* is a contribution of value in connection with the general theory of osmosis. Somewhat more popular in its appeal is the illustrated account of *Tree Surgery*, with its stunning cover picture, among others. *Balanced Rations from Restricted Sources* covers a subject which is attracting more and more attention in these days when it becomes plain that we can no longer go on forever eating as much as we want of whatever we happen to fancy. Those interested in aviation will read with interest the description of *Experiments with Tandem Planes*. The Director of the Copenhagen Observatory gives an outline of recent theories with regard to *The Origin of Comets*, and the ground upon which they are based. *The Biological Character of Fatigue* was the subject of a recent investigation, the account of which is abstracted from a foreign source. Other shorter articles of interest are to be found in the issue, most important of them being a description of the *Tabanuco Gum or Porto Rican Elemi*.

## United States Chemical Warfare Service

(*Continued from page 319*)

the Bush River. Excavation of the foundations started June 12th, and had it not been for the close of the war, the first 10,000-kilowatt unit would have been started on December 1st, the second unit on January 1st, and the whole power house in all its details would have been complete by February 1st.

### The Chlorine Plant

The chlorine plant includes a shop building, cell house, rotary converter substation, and salt-treating buildings. The salt-treating building, measuring 175 ft. by 223 ft. and 40 ft. in height, involved heavy concrete work, both in the tank foundations and in the salt-treating tanks. There is also an extremely intricate system of piping connecting the tanks and the centrifugal pumps for handling the brine. We present an excellent view of the interior of one of the cell rooms. The cell used is known as the Nelson cell. Current for the operation of the cell building was brought in by a high-tension transmission line, which was built across country to intersect the source of supply ten miles distant. The current is led to a rotary converter sub-station, and thence to the cell room.

On July 15th, the chlorine plant was ready to deliver 2½ tons of gas daily to the chemical plant, and the rapidity of the work will be understood when we state that the site of the plant was selected only on March 27th, and in less than four months from that date it was ready to produce gas and deliver it by pipe line to a point about 2,500 feet distant from the place of production.

### Mustard Gas

Of all the gases used by the Germans, perhaps the most dreaded was mustard




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gas. Not only does it have a quick action upon the eyes, blinding the soldier temporarily, but it very quickly produces severe hoarseness and inflammation of the lungs. Furthermore, it will pass easily through clothing and produce painful wounds similar to those caused by the burn of phosphorus.

Mustard gas is produced by passing dry, pure ethylene into sulphur chloride within closely defined limits of temperature, and the reaction may take place either in cast-iron vessels or wrought-iron vessels lined with lead. It is necessary to maintain large cooling surfaces, and the reaction is apt to be accompanied by destructive effects which are difficult to control. If anything goes wrong, great volumes of hydrochloric acid are given off, accompanied by highly toxic gases whose composition has not been determined. Since the gas is strongly lacrymatory, it can be understood that, altogether, the operators are subject to great discomfort and risk of very serious injury. The manufacture started with one and a half tons per day in July. On the 11th of November, it was 28 tons per day and the total capacity, as we have said, would have been 100 tons a day by the first of January. To provide for accident at Edgewood, or in case of a sudden increased demand, the Arsenal also constructed a plant with a capacity of 25 tons per day at Hastings-on-Hudson.

*(To be continued)*

## Recent Patent Invention

*(Continued from page 322)*

tion, and while the meaning of that document can be illustrated by the solicitor's arguments, or the patentee's admissions, which are part of the file wrapper contents, a copy of an advertising publication submitted to the examiner before the patent was issued cannot be considered as evidence of the basis for the grant of the patent. Every claim represents a separate cause of action, and cannot be helped by other good claims, but must stand on the disclosure as interpreted and measured by the prior art. The Stumpf patent, therefore, for an improvement in steam engines, relating to the heating of the steam within the cylinder near the inlet port, by maintaining live steam in the cylinder head, held, valid and infringed.—*Stumpf v. A. Screiber Brg. Co. U. S. C. C. A. of N. Y.*

**Concealment of an Invention.**—If to the rule that no patent may validly issue for anything known or used in the country before its invention by the patentee, there is an exception that when an inventor conceals or suppresses knowledge of the invention, his claim is subordinate to that of a subsequent bona-fide inventor of the same device, such exception must be confined within narrow bounds. The first inventor must have determined to practice his invention secretly, and his efforts to keep the invention secret must have been successful. An inventor, who makes up his mind not to patent his invention, or not to patent it until he thinks someone else is about to invade his monopoly, forfeits all right to a patent.—*The E. W. Bliss Co. v. Southern Can Co. U. S. D. C. of Md.*

**When Estoppel Does Not Hold.**—Provision in a contract for the use of patented apparatus that, in any suit by lessor against lessee, the latter shall not attack the validity of the patents, must be limited to a preceding condition for the payment of rent, and does not estop lessee when sued by lessor solely on account of lessee purchasing and using other apparatus regarded by lessor as an infringement.—*Paramount Hosiery Form Drying Co. v. Moorehead Knitting Co. U. S. D. C. of Pa.*

## Measuring Visible and Invisible Light

AN important place in scientific work is held by the measurement of the intensity of radiant energy. Not only is such measurment interesting on its own grounds, but it is frequently essential in connection with investigations in other

fields. Formerly it was possible to effect it only by converting the radiant energy into heat. Satisfactory enough in some connections, this limitation was, in others, a source of inconvenience and error. Accordingly the Bureau of Standards has for 10 years or more been pursuing the subject, with a view to establishing standard procedures of a definite character; and in a recent summary of the work to date, published by the Bureau under the title Scientific Paper No. 319, some very interesting results are disclosed.

In the radiometer of the old type, the radiant energy is absorbed by a blackened receiver and converted into heat, which is then measured in various ways. In the Nichols radiometer, the absorbing members are vanes suspended in partial vacuum; and the absorbed energy affects the molecular action of the gas remaining in the chamber sufficiently to cause a reaction in the form of a rotation of the vanes. In the thermopile the thermocouple is used, depending upon the fact that when the junction of two different metals is heated, an electric current is set up. For the purpose before us, the heating is here done by the heat generated from the absorbed energy, and the resulting current is measured by a galvanometer. Still another type is the Langley bolometer, in which the electrical resistance of a metallic strip is changed under the influence of the radiant energy absorbed. In addition to all of these successful devices, measurement of radiant energy has been attempted on a basis of the expansion caused when it is absorbed by a gas or a metal and converted into heat; but this procedure does not afford sufficient accuracy to be considered seriously.

The outstanding feature of all these installations lines in their inability to pick out a train of radiant energy of a particular wave length, or even all trains within a given rage. The rays which have so far been measured vary in length from .000004 inch in the extreme ultra-violet to .013 for the longest infra-red rays yet isolated. The absorption radiometer reacts indifferently to stimuli throughoutth is range. The several types vary only in speed—if it requires two seconds to obtain a galvanometer reading, the thermopile will take three or four seconds, and the vane device may need as much as four or five minutes.

Now this universal sensitivity may well be an advantage in cases where we wish to measure the total intensity of a highly complex beam. Such a measurement plainly could not be made with a single instrument of restricted range. But on the other hand, if what we want is to detect the presence and measure the intensity of certain wave lengths, the non-selective apparatus is worthless. We must devise an instrument which will react only to the lengths with which we have to do. In previous communications, the Bureau has directed its attention principally to the non-selective and selective types, finding these of wider application than instruments which respond only to certain frequencies, whether visible or not. But it has been found desirable to turn now to the other kind; and the report which we here summarize records the efforts made to develop a satisfactory selective radiometer.

Perhaps the first thing that would occur to an investigator in this field is that the property possessed by various elements, but by selenium to such an extent as to be ordinarily thought of as characteristic of the latter, would afford a fine point of attack. The property referred to is, of course, that of decreasing electrical resistance under exposure to radiant energy of short wave-length, especially the visible and ultra-violet portions of the scale. It is known that the character of this pehnomenon is wholly a function of the wave-length of the stimulus. It does not in any way depend upon thermal conditions, that is to say, upon the rise in temperature consequent upon exposure to and absorption of the energy in question. In fact, some of the substances which have this characteristic undergo the greatest change in resistance for radiations of the wave-lengths which are least absorbed.

Unfortunately, however, the selenium cell and its cousins are not available for the purpose in hand, The sensitivity depends upon heat treatment, and varies not only with the wave-length of the stimulus, but also with the intensity. In order to use it as a quantitative radiometer, it must accordingly be calibrated for intensity and for wave-length; and this involves comparison measurements with some form of non-selective instrument. Again, the selenium cell is "stiff"; after exposure to light, it is very slow to recover its normal resistance; when exposed for five seconds to low-intensity radiations, it takes as long as 30 seconds to return to its "dark" state. When this intensity was increased 20 times, the response was multiplied only by eight, while the delay in recovery to normal resistance was increased four times. Exposure to daylight required ten minutes for recovery. Another complication is that a crystal formed in the cooler part of the furnace has its maximum sensitivity in the violet, while one from the hottest area shows maximum sensitivity in the extreme red—just as is true of an ordinary selenium cell, which, no doubt, is composed of mixed crystals. Annealing the cell results in further modification of the point of extreme sensitiveness. On all these grounds it appears that selenium as such does not have a characteristic wave-length sensitivity curve, and that it is accordingly not an accurate agent for the registry of the data as to radiant energy totals.

This throws us back upon a third-class of instuments with which the Bureau has done excellent work, and which it finds well adapted to the requirements. This group has to do with substances which, when charged to a negative potential in an evacuated chamber, lose their charge upon exposure to light, especially to the violet and ultra-violet. When thus used they are designated photo-electric cells. The photo-electric cell ceems to become fatigued, and its response is not directly proportional to the intensity of the stimulus but unlike selenium, this lack of proportionality does not depend at all upon the wave-length. This device accordingly appears to meet the requirements of a quantitative radiometer. It may be effectively used for measuring ratios of intensities extending from the blue throughout the ultra-violet part of the spectrum.

Those interested in a more detailed statement of the work and the results under this investigation should apply to the Bureau of Standards for Scientific Paper No. 319, the price of which is 10 cents.

## Air Screens for Furnace Workers

AN account was recently given in a German technical paper of the latest methods employed in Germany for screening furnaces. Workers tending furnaces, and required to examine the glowing material at frequent intervals, suffered a great deal from the excessive heat radiated, and various devices have been tried to minimize the ill effects. For example, hollow water-cooled furnace doors have been tried, but obviously they afforded protection only while closed. Again, devices have been installed for drawing off the hot air in front of furnaces by centrifugal exhausters placed in front of the furnace opening. An objection to these is that workers are subjected to great variations in temperature prejudicial to health. According to the article quoted, the most effective device is to fix immediately behind the furnace door a narrow, oblong nozzle, through which cold air is blown upward, thus interposing a screen of relatively cool air between door and furnace. This arrangement is to give adequate protection to the worker, and has the incidental advantage when the doors of the furnace are opened the escape of flame is checked.

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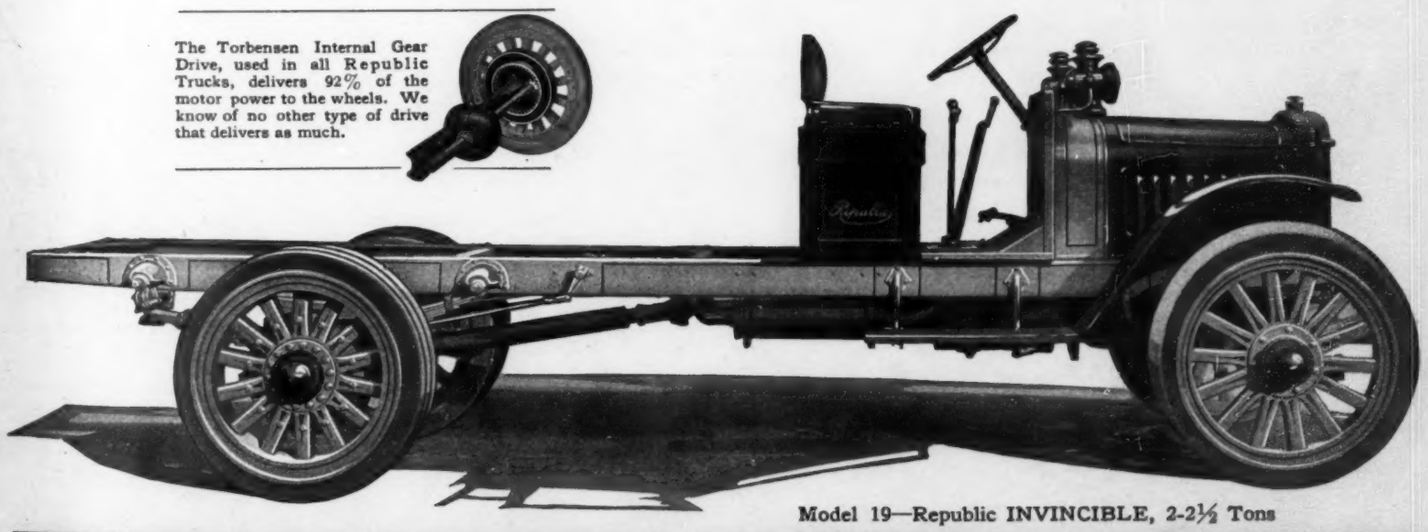

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